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Dollars for the Comet

TWO Christmas boxes have been presented to all those who have the welfare of this country, and in particular its aviation industry, at heart. No. 1 is the first dollar order for the outstanding aircraft of the year, the D.H. Comet; No. 2, from its makers, is the summary of its performance (reproduced on page 783), which substantially confirms the most sanguine hopes regarding its speed and range capabilities. We can think of no single aircraft which has done more to enhance the reputation of the British aircraft industry within months of its maiden flight—and this at a time when such a fillip was most needed.

The figures, 490 m.p.h. for cruising, maximum still-air range of 3,540 miles, and practical range with full payload (12,000 lb) of 2,645 miles, are such that operators will find them both arresting and challenging. The all-up weight of no less than 105,000 lb will come as a surprise to the many who were thinking in terms of well under the hundred thousand.

On the hotly discussed question of North Atlantic operation, it is now made clear that the Comet as it stands could carry 8,750 lb payload on the Prestwick-Gander route with 50 per cent regularity. This is not expected to be the first route operated by Comets, but the possibilities with the performance improvements which will undoubtedly follow further development are, to say the least, promising.

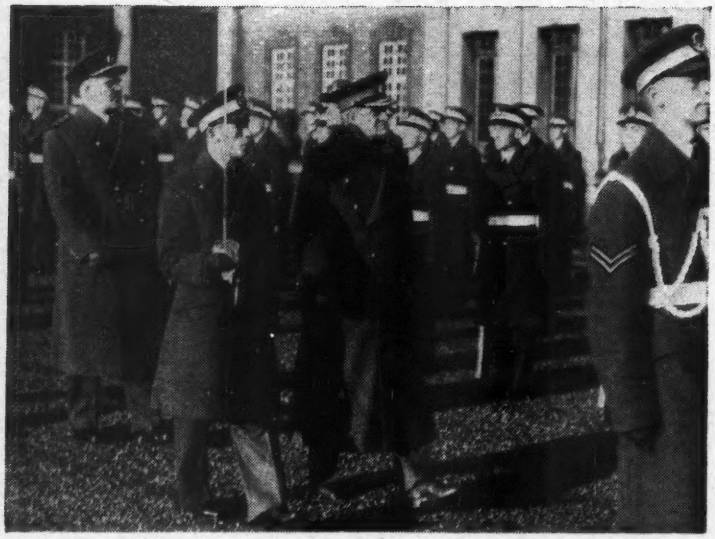
In considering these figures and the practical achievements to date, it is necessary to remind ourselves again that it is still less than six months since the Comet took the air: July 27th was the date. Thus, guardedly, the makers now state that improvements are expected later on in range and payload, following an increase in thrust for take-off from the four Ghosts and a decrease in specific consumption. Conceivably, thrust augmentation—liquid injection, perhaps, on a civil aircraft—could be in mind for take-off, additionally or alternatively to the two Sprite rocket motors.

Club Cheer

AS another year of private flying comes to an end a very small ray of sunshine breaks through the gloom of heavy weather, both literal and metaphorical, with which the flying clubs are, and have been, battling. Remembering past disappointments occasioned by false hopes (put not your trust in politicians!) we venture to refer to this matter only after earnest consideration. But it does seem that the straw proffered by Mr. Geoffrey de Freitas at the Herts and Essex Club dinner last week, though vague and nebulous—of necessity, no doubt, at this stage—was grown on fairly firm soil. Substance is lent to the assumption by several considerations: Mr. de Freitas, we believe, has the welfare of the clubs at heart, for he is a keen private pilot himself and a member of the Herts and Essex Club. Moreover, he was speaking as the evening's chairman in the presence of, and responding to a toast by, the Chief of Air Staff designate, Air Chief Marshal Sir John Slessor; and he coupled the R.A.F. with his statement regarding the clubs. The statement itself, surely worded with care ("... not unhopeful that they may be unable to evolve some system which will benefit not only the flying clubs but your very great Service, the R.A.F.") would be pointless in its very vagueness were it to lack foundation.

In spite of all their difficulties, most of the flying clubs have had a better year than they had dared to hope. Keenness is, if anything, greater than ever before, and any reduction in flying hours reflects mainly the high cost of private flying which, in fact, has placed it beyond the means of most people. Even the aircraft situation gives some grounds for satisfaction, for there are quite modern and economical light types available, and manufacturers have even contrived to introduce new models, notably the Autocar and Skyjeep. That Chipmunks are in production for the R.A.F.V.R. may well be of importance to the clubs in the future.

On these showings, club members may perhaps be safe in raising a small Christmas glass with sober optimism (as will *Flight* staff) to "Aid for the Private Pilot in 1950."



PASSING-OUT PARADE

Cranwell's 48th Entry Reviewed Before Leaving College

Illustrated by "Flight" Photographs

Field Marshal Sir William Slim, followed by Air Cdre. Beamish, inspecting the cadets. (Right) Presenting the Sword of Honour to Flt. Cadet Under-officer J. R. E. Edmondson-Jones.

ON Wednesday of last week, a perfect winter's day, Field Marshal Sir William J. Slim, G.B.E., K.C.B., D.S.O., M.C., Chief of the Imperial General Staff, reviewed No. 48 Entry on the completion of their course at R.A.F. College, Cranwell.

The low December sun and the clear blue sky, throwing the College building into high relief, formed an ideal backcloth for the parade—a scene spoilt only where corrugated roofing and temporary brickwork still covered wartime scars. The perfect conditions may have had something to do with it, but the impression was gained that College standards are nearly back to those of pre-war days. The drill, with all its peace-time embellishments, was virtually perfect and the slow march-past in line, if a trifle funereal, was immensely impressive.

After taking the salute Sir William motored to the airfield to inspect the Flying Wing which, for the first time, boasted a Meteor 7 among its aircraft. Flanking the Meteor were two Ansons, twelve Prentices and twelve Harvards.

At the close of the inspection, cadets, guests and friends forgathered in the gymnasium for the prize-giving, where Air Cdre. G. R. Beamish, C.B., C.B.E., Commandant of the College, addressed the assembly and thanked the Field Marshal for his attendance: he pointed out that ten days previously Sir William had performed the same duty at West Point in the U.S.A. and would the next day be at Sandhurst to take the Sovereign's Parade of officer cadets.

The Commandant went on to speak of the changes which had come about at Cranwell, and of how the cadets of No. 48 Entry had themselves observed, during their time there, the increasing emphasis and requirements of flying training. They had seen, he said, a re-organization of the programme, specifically designed to serve the needs of flying training while still retaining a balance with continued education and officer training.

A laugh greeted Air Cdre. Beamish's remark that No. 48 were the last entry to complete their basic training on Tiger Moths, and so would be the last to be able to bore their grandchildren with tales of "the old biplane days." On the other hand, he said, doubtless they have seen (with some heartburning) the Meteor 7 being prepared to give their successors at least a little passenger experience in high-performance aircraft.

The prizewinners, went on the Air Commodore, are well worthy of their success and I must commiserate with those who ran them extremely close. Flt. Cdt. Under-officer Parkinson was very near indeed to winning the prize for Imperial and War Studies, as was Flt. Cdt. Cpl. Parratt to both the award of the Royal United Services Institution and to the Science and Engineering Prize. Flt. Cdt. Sgt. Clements' excellent showing as a cadet N.C.O. might well have earned him an award.

THE PRIZE-WINNERS

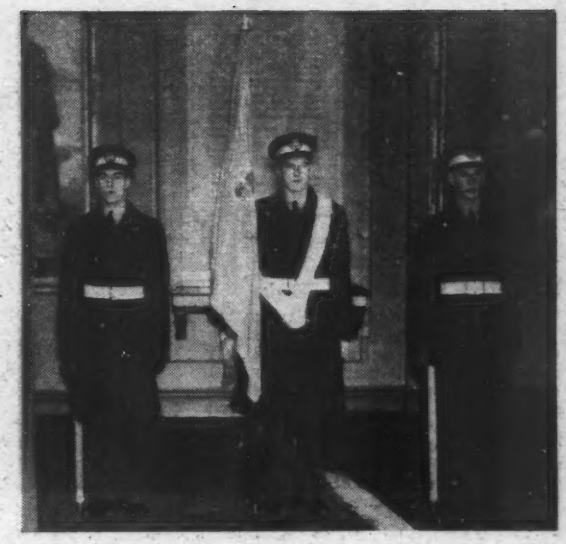
Left to right: Flt. Cdt. Under-officer I. N. Meredith, Philip Sassoon Memorial Prize; Flt. Cdt. Cpl. A. R. L. Chester, Robert Marsland Groves Memorial Prize and Dickson Trophy; Flt. Cdt. Under-officer J. R. E. Edmondson-Jones, Sword of Honour, King's Medal and John Anthony Chance Memorial Prize; Flt. Cdt. Cpl. R. E. Webster, Abdy Gerrard Fellowes Memorial Prize for Aeronautical Science; Flt. Cdt. Sgt. R. J. Spiers, Air Ministry Prize for Imperial War Studies; Flt. Cdt. Sgt. A. N. H. Heap, Royal United Service Institution Award.

After congratulating the entry on the standard attained, the Commandant pointed out that there were now more applicants than places in the College, despite an intake which is nearly double that of the entry which was leaving.

Sir William Slim then presented the prizes, having a few moments sincere talk with each recipient. In his subsequent speech, addressing his remarks mainly to the cadets, the Field Marshal gave his definition of leadership. It was, he said, a projection of a man's own personality and required the qualities of courage, will-power, initiative and knowledge.

We came of a race never short of courage, Sir William said, but it was just that extra ten minutes of bravery that was required. Will-power meant forcing people along who had not quite the same degree of courage—but inflexibility of mind was a dangerous pitfall. Initiative meant not waiting for things to happen, and always being ahead of the men under command, whether one was a flying officer or a field marshal. In the pursuit of knowledge one should learn during the whole of one's lifetime.

Finally, said Sir William, good leadership meant that self-sacrifice must dominate everything else. A good officer must be the servant of his men, and their interest must come first. "The men are all the same," he concluded, "and there are no good or bad squadrons—there are only good or bad officers."



The King's Colour Party: Ensign, Flt. Cdt. Cpl. W. F. Knapper. Escort, Flt. Cdt. Cpls. A. S. H. Black and A. Turner.

COMET ASSESSMENT

Official Statement Based on the Measured Performance of the First Aircraft

ALTHOUGH the existence of the de Havilland Comet, either under the manufacturer's designation 106 or under the type name itself, was known for quite some considerable time before the aircraft was presented to public view, the very fact that this début did not occur until almost immediately prior to the aircraft's first flight, and after months of conjecture, invested the whole presentation with no inconsiderable dramatic value. It is, perhaps, not too much of an exaggeration to state that the appearance of the Comet created a considerable flutter throughout the whole aeronautical world, and not least in America.

Since the first flight of the Comet, on July 27th, so swimmingly have the main handling trials gone, and so spectacular have been some of the flights, that the already considerable interest in this singular aircraft has, if anything, become emphasized. Now, after four months of intensive work, the handling trials and performance measurements have been completed, and an analysis made of the results. Although a good deal of development will doubtless be built into those aircraft which are scheduled to go into service in 1952-53, de Havillands themselves feel that, in view of the importance which attaches to a realistic understanding of the aircraft, it is more satisfactory to issue a statement based on the performance achieved by the first aircraft in its first few weeks of flight, rather than to publish estimates of future capabilities.

It is officially stated that the Comet has a cruising speed of 490 m.p.h. at an all-up weight of 105,000 lb and, as a 36-seater, a capacity payload of 12,000 lb. With this maximum payload its Still-Air Range (standard atmosphere, no wind, no allowances) is 3,540 statute miles. The corresponding Practical Range is 2,645 miles, i.e., with due allowance for ground running, taxying-out, take-off, climb and descent, navigational errors, airframe and engine variation and deterioration, the Comet with 12,000 lb payload can fly to a point 2,645 miles distant and, on arrival, have sufficient fuel left for 30 minutes of circuits and stand-off prior to approach, landing and taxying in. By reducing the payload to 6,000 lb, the practical range becomes 3,000 miles; with no payload, it becomes 3,220 miles.

Additional allowances for head wind and diversion to an alternative airport are necessary in order to arrive at the stage lengths that can be operated. For example, the practical range of 2,645 miles with 12,000 lb payload represents a stage length of 2,140 miles, plus 200 miles diversion allowance, all against a head wind of 50 m.p.h. These loadings to 105,000 lb call for a runway length of 2,175 yards, and at this weight the Comet is stated to have a satisfactory three-engine climb gradient.

In the October 27th issue of *Flight*, details were given of the interior layout devised for a 36-seater version of the Comet, but de Havillands now announce that, in addition to the 36-seat arrangement, a scheme has been prepared for a 48-passenger version which, with a payload capacity of 14,000 lb, offers attractive possibilities for use over the shorter stage lengths. As an example, it is stated that, operating from a 2,000-yard runway in standard atmosphere (the shorter runway limits the take-off weight to 101,000 lb), the Comet (furnished with 48 seats and carrying its full payload of 14,000 lb can operate against a 50 m.p.h. head wind over a stage length of 1,750 miles, plus 200 miles diversion. The aircraft is also economical for stage lengths down to less than 1,000 miles

The fact that jet aircraft are particularly sensitive to ambient temperatures and pressures means that they are somewhat more susceptible to adverse effects when operating in severe tropical conditions than are aircraft powered with piston engines, although the somewhat greater power reserve normally associated with the turbojet offers some compensation in this regard. It is, nevertheless, to cater for operation in the tropics that the Comet is designed to employ two Sprite rocket units housed between the Ghost jet-pipes in the trailing edge of the wing. The Sprite (*Flight*, September 8th) is a liquid-fuel rocket with a maximum thrust of 5,000 lb and it is, at the present time, undergoing test and development by the de Havilland Engine Co.

Some impression has been given of what the Comet can already do. The development work which is currently being conducted, in addition to that on rockets, is expected to yield increases in the thrust of the Ghost turbojet for take-off and emergency climb, a decrease in specific consumption for cruising, an increase in the all-up weight of the aircraft and an increase in the internal fuel capacity. De Havillands are particularly anxious not to mislead potential operators of the Comet, but state that the developments mentioned are confidently expected to produce material improvements in the range, payload and other aspects of operational capability whilst the Comet is still in the early stages of its career.

World interest has been concentrated upon the likely operation of the aircraft on the North Atlantic route. The head wind at height on the westerly crossing is the over-riding operational factor; it varies, seasonally and otherwise, and the payload varies with it. If no development advantages whatever are taken into account, the Comet in its present form could carry a payload of 8,750 lb on the Prestwick-Gander crossing (2,116 miles) with a 50 per cent regularity. Whilst this means that on half the days of the year it could not carry such a load, it also means that on the remaining days, it might well carry more than 8,750 lb and, in any case, it has been calculated that, on four days out of five, its payload would not be below 5,800 lb. These figures for the Prestwick-Gander stage take all allowances into account, including diversion to Goose, i.e., 395 miles.

HERE and THERE

Brabazon Glimpsed

THE Bristol Brabazon I twice appeared over the London area on routine test flights during last week. It has been suggested that public interest in the great Brabazon project would be sustained by a few pre-announced appearances over the larger cities, without, of course, disrupting the testing programme. Many people would thereby gain their first sight of what is, after all, a public investment.

Jets in Japan

MORE than 200 Lockheed F-80 Shooting Stars are now in service with the United States Far East Air Force. This strength will be increased by consignments of F-80s now on their way to re-equip the tactical Fifth Air Force, stationed in Japan. Each fighter is shipped to Japan in six separate sealed packages, following anti-corrosive treatment at the Lockheed factory. The U.S.A.F., incidentally, is now operating over 1,400 Shooting Stars.

Black Mark!

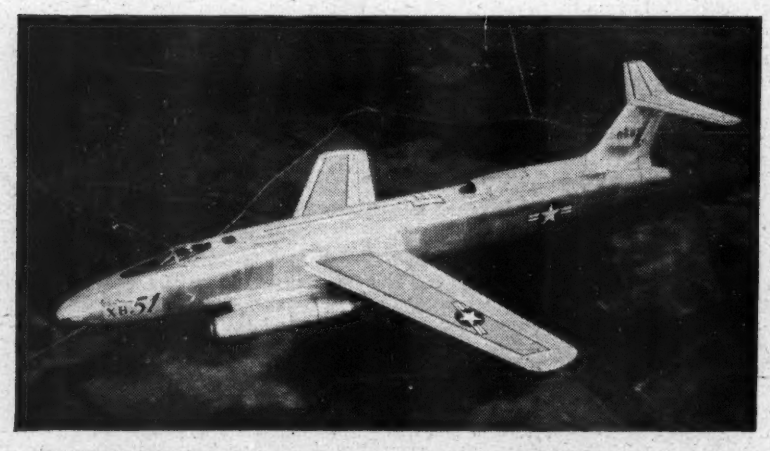
MANY readers must have chuckled at the absurd blunders credited to pilots by aeronautically minded cartoonists. The American Press, however, recently reported the actual occurrence of—seemingly—the most improbable of such errors.

It happened at the U.S. Naval base at Charleston, where student pilots were one day practising simulated carrier take-offs on Douglas Skyraiders. One of the aircraft, according to procedure, taxied up to the take-off point with wings folded, and, at full engine boost, continued straight down the runway in this highly unairworthy condition. After a 2,500ft run it unfortunately became airborne, and began a very gradual climb to 250ft. The pilot was removed, bruised but conscious, from the ensuing wreck and asked "What happened?"

CHIMNEY-PIECE: This picture (alleges the photographer) is evidence that proving-flights of the Reindeer Special have been made this week, and that Master Pilot S. Claus, once again in charge of the Toy Lift, has been making practice approaches to his intermediate stops.

Tribute to Test Pilot

AT the inquest on S/L. Michael Graves, D.F.C., assistant chief test pilot of the Westland Aircraft Company, the foreman of the jury stated that "he purposely went to certain death rather than the rest of the town should suffer by a more serious accident." Verdicts of death by misadventure were returned on S/L. Graves and three civilians killed in the accident to a prototype turboprop-powered Wyvern on October 31st. The pilot crash-landed the aircraft on the airfield at Yeovil after power-failure, but it rebounded and struck houses alongside the field.



STRICTLY MILITARY: First air-to-air study of the new Martin XB-51 jet bomber, which was designed for low-level, ground support work. Novel design features include the variable-incidence, raked wings and the installation of its three General Electric J-47 axial turbojets, each of which develops 5,200 lb. thrust.

Nine Days Left

THE Treasury announced recently that the Royal Commission on Awards to Inventors will not be able to consider claims which have not been notified to the appropriate Government department by December 31st, 1949.

Military Aircraft of the World

FLIGHT for January 26th next will be a greatly enlarged and specially illustrated number discussing the requirements, design, performance and use of military aircraft of all countries.

L'Aviation Militaire dans le Monde

LE numéro de FLIGHT du 26 Janvier prochain sera une édition beaucoup plus importante et spécialement illustré, dans lequel seront traités objectivement les sujets intéressant les qualités requises, constructions, performance et l'utilisation des avions militaires de tous les pays.

Aviación Militar Mundial

LA tirada de FLIGHT correspondiente al 26 Enero proximo estará constituida por un número considerablemente aumentado y especialmente ilustrado, en el que se discutirán las necesidades, construcciones, ejecución y uso de los distintos aviones militares de todos los pàises.

Air Training Agreement

AN agreement signed in London on December 14th between Britain and Southern Rhodesia provides that land at present in use for the air training scheme in Southern Rhodesia will continue to be available to the Air Ministry without charge, and that land required for the normal development of airfields shall also be provided free. Mr. Arthur Henderson, who signed the agreement on behalf of this country, announced that the Southern Rhodesian Government had

HERE AND THERE . . .

also agreed to provide 300 married quarters for the R.A.F. over the next three years.

Power Parley

A NUMBER of papers of direct aeronautical interest will be delivered at the Fourth World Power Conference, which is to be held in London from July 10th-15th next year. Among the British lecturers will be Mr. F. Owner and Dr. S. G. Hooker, of the Bristol Aeroplane Company, Ltd. Copies of the provisional programme of the conference can be obtained from the Conference Offices, Fourth World Power Conference, 414, Cecil Chambers, 76-86, Strand, London, W.C.2.

Gala Benefit

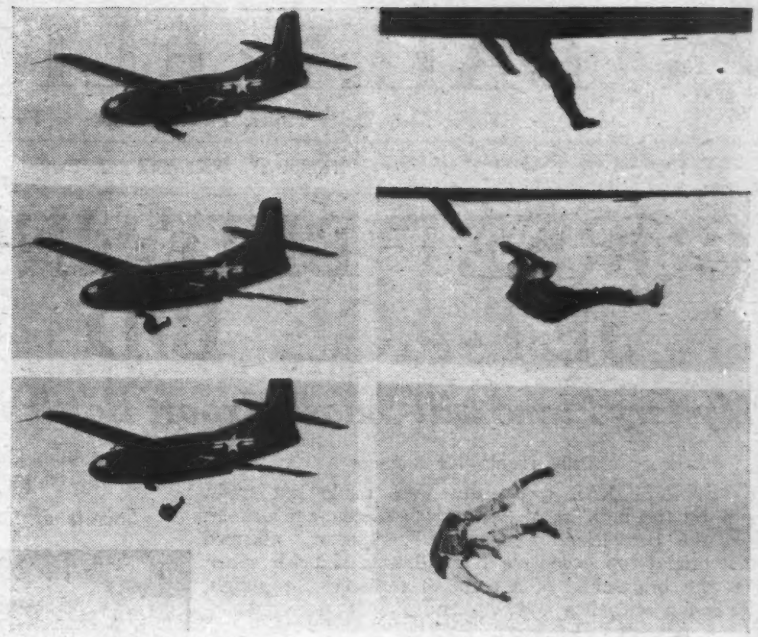
ON the evening of Wednesday, December 7th, in the presence of the Duchess of Kent, a gala performance of the comedy *Three Men on a Horse* was given at the Scala Theatre, London, by the Stock Exchange Dramatic and Operatic Society, in aid of the Royal Air Force Benevolent Fund. Among the distinguished guests in the audience were Lord and Lady Riverdale, A.V-M. Sir John and Lady Cordingley, Air Marshal Sir Hugh Saunders (Inspector-General of the Royal Air Force) and Air Commandant Dame Felicity Hanbury.

"Operation Backfire"

AT the film show organized by the British Interplanetary Society and held on December 3rd at the Science Museum, South Kensington, three films were presented.

Operation Backfire, showing the assembly, transport, fuelling, and firing of German A-4 (V-2) bombardment rockets during the British-conducted Cuxhaven trials was of outstanding interest. *Faster than Sound* dealt with the test flight of the Vickers air-launched supersonic rocket model but was less informative; presumably the film was produced for exhibition to the general public, and it suffers by reason of its "over-popular" treatment. Part of that excellent film *Atomic Physics* was shown in view of the possible use of atomic energy for rocket propulsion.

The Interplanetary Society is to be congratulated on the vigour with which it seeks to promote study of rocket engineering, astronomy, electronics and associated sciences.



DOWN THE HATCH : Unlike the majority of jet fighters, the two-seat, twin-jet Douglas Skyknight all-weather fighter is not equipped with ejector seats. Instead, the pilot and radar operator can make emergency exits beneath the fuselage, *via* a gravity chute. One of 22 successful tests of the chute (at speeds up to 450 m.p.h.) was photographed in sequence from an accompanying aircraft, and also (right-hand strip) from the wing-tip of the Skyknight itself.

Record in Comfort

TOM LANPHIER, a former U.S. fighter pilot, recently made what is claimed to be the fastest passenger flight round the world by commercial airlines. The journey, which was to commemorate the anniversary of the Wright Brothers' first flight, took four days 23hr 7min. Mr. Lanphier left Washington on December 2nd and, after flying 22,000 miles, returned on December 7th. On his flight he carried a message from President Truman, which he delivered last week at the annual Wright Memorial ceremonies at Kitty Hawk.

SOUTH AMERICAN VAMP : Capt. Buenaventura Vivas and Lt. Roosevelt Abuianza, of the Venezuelan Air Force, inspect a D.H. Vampire at Hatfield. The first Vampire was recently delivered to Venezuela—twelfth nation select the type.

NEWS IN BRIEF

THE Women's Junior Air Corps, which claims to be the only youth movement with its own aircraft (a Fairchild Argus), was recently given a Link Trainer by Shell-Mex and B.P., Ltd.

* * *

Mr. George Wiltsher has been appointed publicity manager for both the car and the aircraft engine sides of Alvis, Ltd., Coventry, as from December 1st. Before joining Alvis he occupied executive posts in two well-known advertising agencies.

* * *

The application of "Claytonrite" self-sealing weatherstrip for vehicle and aircraft windows is the subject of a brochure from Howard Clayton-Wright, Ltd., Wellesbourne, Warwicks. The material has been used on the Westland-Sikorsky and Bristol helicopters among others.

* * *

In a letter to the Editor, the Johannesburg Assistant City Librarian expresses gratitude to readers who have responded to her second request [Correspondence, November 3rd] for a long-out-of-print issue of *Flight*. "Once again," she says, "the response has been prompt and generous." *Flight*, too, is very appreciative of this co-operative spirit among its readers.

* * *

In describing, at the annual general meeting, considerable extensions being made at the Hamble works of Folland Aircraft, Ltd., the chairman mentioned "a department for the practical application of plastics to aircraft . . . for which work we are covered by orders." Among other work in hand (in addition to a substantial Vampire-component contract) were wings for the Venom and Chipmunk and "important projects" for the Bristol Aeroplane Company.

XMAS SPECIAL EDN.

DAILY FLIGHT

The Unique Daily Paper, Published Once a Year—Perhaps!

No. 1 THURSDAY, DECEMBER 22, 1949 Page 1

CORNET BRITAIN'S JET-AGE BID

Mystery Plane will Smash Export Bottleneck

TODAY'S WEATHER

Special long-range forecast by the Marx Brothers:—

ICY CALM, CHAPS, ICY CALM

Moon rises, 10.42 p.m.; sets, 11.13 p.m.
High water at Northolt, 3.30 a.m.

"Daily Flight" Air Reporter

SENSATIONAL disclosures were made last night by the builders of Britain's first atom-age airliner, the Beaverland Cornet. "The Cornet," affirmed Beaverland top executive I. Holdforth, sixtyish, sober, "is the brain-child of a team of top-secret, top-flight backroom scientists and workers.

Asked why this all-British, all-Beaverland contender for world air supremacy had been named Cornet, Beaverland boffin-boss V. Clued confided that the epoch-making new jetplane had wafer-thin wings of sandwich construction, protected against ice by the cream of Beaverland's research staff.

Enthused Clued, thick-lensed, thirtyish, "This means that the Cornet can hurdle sonic walls and attain the airman's Eldorado."

Four of Beaverland's hush-hush Spook jetmotors purred into a shattering scream as engine-boss I. M. Peller, sixtyish, single-faced, confided, "The prototype Spook has already flown for several minutes in a re-vamped Mossie at Preston."

Chocks Iced

Quizzed after landing from the Cornet's maiden flight, in the course of which he completed the Naples-Vanilla round trip in record time, thus securing for Britain the coveted Coupe Jacques, top Beaverland test-flier B. W. ("Dog's Nose") Spinningham, greying, seventyish, reported, "The Cornet is a piece of cake. She will slice seconds off the current Madeira fruit-run."

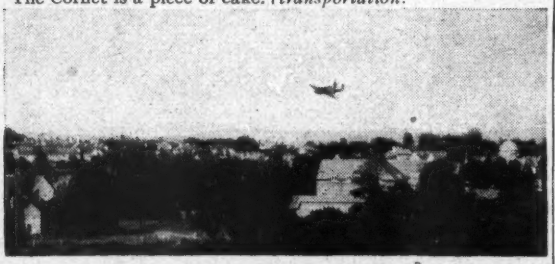
Put in flight observer Forthright, twentyish, twitching, "She went like a bombe."

Pronounced airline chief Sir Furlongs Tomboy, burly, boyish, "I intend to expand my corporation with Cornets."

Later, Marlin Blunt, Beaverland's P.R.O., genial, backslapping, disclosed that the Sultan of Marzipan has shown interest in an ultra-long-range, inter-oceanic variant laid out as a flying harem, and adapted for aerial refuelling.

Early this morning an unconfirmed agency report from Montmartre stated that M. Marcel Weive, Beaverland continental sales chief, speaking at the tri-annual banquet of the *Société pour Papier Maché et pour l'Aeronautique*, had described the Cornet as "a chip of the old Bloch."

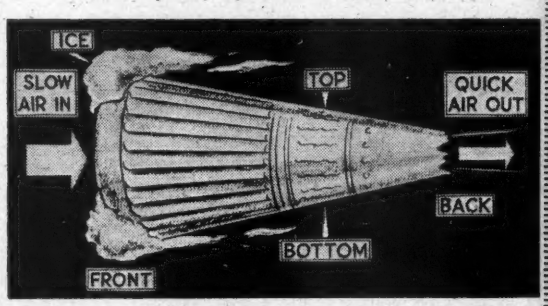
★*A New York message quotes Al. K. Seltzerwasser, Executive in charge of Engineering and Exploitation, Inter-Global Airlines, Inc., as saying: "The British Cornet spells skyrocketing Beaverland backlogs and spotlights tardy technological indoctrination and reorientation in domestic transportation."*



CORNET ROARS OVERHEAD
Closest-ever picture shows hush-hush technical features

HOW IT WORKS

Secrets of the Spook "Fridjet" Revealed



WHEN giant plane hurtles forward each motor gulps 12 tons of air a minute.
AIR meets ice which has formed round the front edge. (Scientists call this part "the intake.")
AS cooled air shrinks, more is sucked in.
BUT casing gets smaller towards rear, so air has to move faster to escape.
IT is released faster than sound, propelling plane forward.
DOLLAR-SAVER: First experimental engine had an atomic refrigeration plant to make the ice. Then Beaverland backroom boys discovered that ice would form of its own accord. So now the Fridjet needs **NO FUEL.**

READERS *WRITE!*

Barrage

From Sir Alum Sherbert, M.P.

Dear Sir,—Will airline pilots please note that from sunrise to-morrow a captive hot-air balloon will be flown from my garden to an altitude of 3,000ft?

ALUM P. SHERBERT.
London, W.6.

Record?

Dear Sir,—I see one of your readers has a hen that laid a china egg. I wish to say my brother that works at Prestwick has laid a concrete runway.

W. FUMBLE.
Wigan.

Rocket

Dear Sir,—Whilst flying my light plane recently, I thought it would be a good idea to have a close-up view of Northolt Airport, so came down to 100 feet and made a few little right-hand circuits, only to be greeted with showers of red rocket things, apparently fired at me by some irresponsible person on the ground.

It is not, Sir, a scandal that people should be allowed to endanger harmless private fliers in this way?

It strikes me as being yet another example of Civil Service interference with the rights of the private citizen.

(MISS) PRISCILLA PRUYNE.
Chorlton-cum-Hardy.

Bats?

Dear Sir,—My eight-year-old son persistently leaps from a first-floor window with a lighted blowlamp pinned to the seat of his little trousers. While doing so he shouts "I'm a vampire." As this seems to make no sense at all I am very worried.

MOTHER OF SIX.
Chipping Sodbury.

Airliner Pilot Drops—

NUTS IN SEA

—and Causes Storm at Westminster

(Unparliamentary Reporter)

IN the Commons last night Sir Josiah Grizzle (Con., Great Coathanger) asked the Minister of Civil Aviation if he was aware that a Tiger Moth plane chartered by British Railways from B.O.A.C. to carry a load of groundnuts from East Africa to Nutts Corner, Belfast, on behalf of the National Simian Food Corporation, had been diverted to the B.O.A.C. base on Southampton Water on the instructions of the National Coal Board, who were under the impression that the cargo consisted of kitchen nuts. (Cries of Oh!)

"Is it not also a fact," asked Sir Josiah, "that the pilot of this non-marine aircraft, on finding that he was expected to land at what was, in fact, a marine base, dumped his cargo in the sea?" (cheers and counter cheers.)

Sir Josiah added that the pilot was reported to have used "most improper language" over the radio-telephone to the air-base control officer. "I cannot say I blame him," he added.

Short Answer

Replying for the Minister, the Acting Unpaid Sub-deputy Secretary said that if such action had, in fact, been taken, it was in contravention of Sec. 5, sub-section (e), para. iii of the Air Navigation Act, as amended by Notams Nos. 396-399 A. B. C and G of 1949; if not, however, the question should be addressed to the Minister concerned, who, no doubt, would be in a position to refer it to the appropriate authority appointed under the terms of the committee constituted in September, 1948, to enquire into the validity of the Coal, Coke and Breeze Block (Damage by Sea-water) (Consolidation) Regulations, 1947. (Government cheers.)

Sir Josiah Grizzle: "Would the Hon. Member agree that he is a consummate ass, unfitted to have charge of a fleet of paper aeroplanes?"

The Sub-Deputy Secretary started to reply that the answer was in the affirmative; then, hastily correcting himself, said that he would give Sir Josiah his answer privately.

A man in the public gallery, who stood up, threw a handful of peanut-shells, and shouted "shucks!", was removed on the orders of the Speaker.

I PROBE BRITISH GASLIGHT JET

Women Scream as Cranberry Bomber Zooms, Banks

By Group Captain
B. LOWE-DYCE ★
("Daily Flight" Special Air Reporter)

YESTERDAY I flew one of our top-secret bombers, the British Gaslight Company's Cranberry.

Already these wonder planes are being served out to squadrons from R.A.F. Station Dishforth.

The Cranberry differs from other bombers in having a low aspic ratio, that is, a wing made broader than it is long. This reduces head resistance, increases speed.

R.A.F. Cranberries have jet turbines named after a famous Bristol river. The export model I flew was to be supplied to the Kurds, had Wey engines.

All Lit Up

Gaslight test pilot R. P. Warhead lit the jets for me, helped me into the luxuriously appointed cockpit. Warning notices were in a strange language; not until I recognized the words "aerodromedaries" and "camelflage" did I remember the destination of this particular plane

Cranberry's jets have afterburners, device named in commemoration of the Irish ground engineer, who, seeing paraffin dripping from jet-pipes following a wet start, enquired, "Would ye not be after burning all that good fuel, begob?" and applied a light to it.

Mantled in Snow

Never since I was catapulted from H.M.S. *Ironclad* in a semi-rigid airship have I experienced such acceleration. Only 17 minutes from the time the wheels were off (both were later recovered, undamaged) we were in ice and snow at 14,000ft.

Remembering my cockpit drill (which later came in useful for boring holes in the floor to release water caused by atmospheric consternation during quick descents from high altitudes), I switched on the alcohol injection to the engines and turned on my oxygen.

In no hurry to attempt advanced aerobatics, I contented myself with what we term subsonic bunts and a brief sequence of eleven - point, twelve-turn upward (if I may use the term employed in the dear old Squadron) Charlies.

Saw Stars

It was at this point that I discovered the alcohol and oxygen supplies to have been inadvertently interchanged, so the test was, perforce, curtailed.

I flew back blind to the airfield, where, on landing, I took the opportunity of testing the ejector-seat. Unfortunately, I omitted to release the canopy first.

"A stunning effect," commented Warhead, laughingly.

NEXT WEEK: *Furry Feet on the Demon Dashboard.*

CRANBERRY'S WING
Laminar Flo is secret of new warplane's speed.

☛ COL THREE

★ ★ ★ ★

★ Ace war pilot, numbers Defence Medal among decorations. Single, 53, lives in a dredger on Basingstoke Canal. Hobbies: progressive jazz, motor racing, penguin-fancying. Author of *My Number's Up, or the Life and Times of Dr. Mach;* and *There I was: A Study of Inversion.*

TRAPPED, EATS GIANT AIRLINER

Charged at Hounslow with stowing-away in the tail of an airliner about to leave London Airport for South Africa, Clarence O'Toole, 35, fitter, was able to prove that he was "walled-up" when the plane was built for the R.A.F. in 1943.

The captain of the aircraft said that he only discovered O'Toole's presence because his (defendant's) beard became trapped in the control wires.

O'Toole told the Magistrate that he had subsisted on rivets which he removed from the structure.

The Magistrate: Rivets?

Defendant: They were cheese-headed rivets.

The Magistrate: Well I never.

O'Toole was discharged on giving an undertaking not to repeat the offence.

BRITISH JET ENGINES BEST

—blonde will Tell Scientists

"Daily Flight" Reporter

Blonde, glamorous 18-year-old Ivy Fudge is to be Miss Jet Pipe, 1950.

She was selected from 21 other contestants who paraded before officials of the Jet Engine Manufacturers' Association in London yesterday.

Miss Fudge, at her Ponders End home, told me she was delighted to have the opportunity of making a contribution, "however insignificant," to next year's organized effort to prove that British jets are unrivalled in technical superiority.

"When the gentleman told me," added Miss Fudge, "you could ol knocked me down with a feather. Mum was ever so pleased and doesn't mind, seeing I am a girl that keeps herself to herself, gets home early, etc."

She is to open the campaign in January by reading a paper before the Society of Gas Turbine Engineers.

STOP PRESS

Airliners stood by at London Airport this morning after a reported collision between an ambulance and a fire engine.

JET-AGE BID

(See p. 1)

Wages frozen at Cornet works.

CIVIL AVIATION NEWS

COMETS FOR CANADA

AS the result of a decision reached after exhaustive studies of the de Havilland Comet on the ground and in flight, Canadian Pacific Airlines have placed an initial order for two aircraft, to be used on the Vancouver-Tokyo-Hong Kong service. Delivery is expected for 1952 or early 1953. This welcome news constitutes a most important step towards international acceptance of commercial operations with jet aircraft.

At present operated with Canadairs, the 6,800-mile Vancouver-Hong Kong route has three stopping points: Anchorage (Alaska), Shemya in the Aleutians and Hong Kong. The stage distances involved are: Vancouver to Anchorage, 1,400 statute miles; Anchorage to Shemya (Semitchi), 1,550; Shemya to Tokyo, 2,100; and Tokyo to Hong Kong, 1,850. Intermediate points are G.C.A.-equipped, having been prepared originally as major air bases in the Pacific campaign. Prevailing winds in the Aleutians are westerly and, although fog is prevalent in this area, there has so far been no frequent interference with the Canadair services. On the longer stages, the weather is almost always good. It is anticipated that this lengthy route, representing, as it does, a quarter of the distance around the world, will be accomplished in an elapsed time of less than 20 hr, including three one-hour stops.

C.P.A. also operate a service from Vancouver to Honolulu and Australia, and the fact that negotiations are now in progress for a further two aircraft (for delivery at a later date) suggests that the company may be considering the introduction of Comets on this route as a second-stage development.

The possibility of a Comet with extended fuselage has recently been under discussion, but it is understood that for the time being only the standard fuselage will be produced.

It is assumed that C.P.A. will receive Comets Nos. 17 and 18, which will follow the already announced order for 14 from B.O.A.C. Negotiations for the first C.P.A. order were completed by Mr. G. W. G. McConachie (president) and Capt. Pentland (operations manager for the Pacific area) during a recent visit to the United Kingdom.

This very significant order should mark the beginning of a long career of dollar-earning for Britain by what is undoubtedly the most promising airliner currently offered to the world's operators.

CHARTER CONTROVERSY

THE recent transfer to B.O.A.C. of the contract for flying personnel of the Overseas Food Corporation to East Africa was the subject of severe Opposition criticism in the House of Commons last week. It was alleged that the negotiations for the renewal of the contract had been conducted in an unorthodox commercial manner, and that B.O.A.C. is now operating the service uneconomically—thereby placing an unnecessary burden on the taxpayer. The allegations were denied by the Parliamentary Secretary to the Ministry of Civil Aviation, Mr. Lindgren, and by Sir Miles Thomas, Chairman of B.O.A.C.

A statement has been issued by Hunting Air Travel—from whom the contract was transferred to B.O.A.C.—protesting against accusations by Mr. Lindgren that the company was not observing the "fair wages" clause of the Civil Aviation Act, and expressing the view that the Government is displaying a policy of endeavouring to eliminate every air-charter company "by one means or another." Loss of the contract has caused redundancies amounting to 30 per cent of the company's staff.

Though no further developments have occurred at the time of going to press, it may be assumed that more is likely to be heard of the matter.

HERMES DELIVERY

DELIVERY of the first of the B.O.A.C. fleet of 25 Hermes aircraft is expected in the immediate future. Results of route trials (due to begin early in the new year) and the final rate of delivery of the aircraft will determine the date of their introduction into service. The Corporation states that it is intended to use the Hermes as replacements for the Solents employed on the South and East African routes and that the substitution may begin next summer.

WHAT, NO MISTLETOE? Christmas decorations in the cabin of a K.L.M. Constellation will assist in providing the traditional atmosphere for travellers obliged to forsake the Yule-log fireside.

STATE CONTRIBUTION

REPLYING to a question in the House of Commons, Mr. Strauss (Minister of Supply) revealed that the total contribution made by his department towards development of the D.H. Comet was estimated at approximately £4,000,000. The main item was said to be the cost of the development of the Ghost engine, which might also be used in other aircraft. Other expenditure was on three prototypes of the D.H.-108 built to obtain experience of the aerodynamic problems of the Comet project.

The Comet which was now flying and the second prototype which was nearing completion, had been purchased by the Ministry of Supply, and would both be used for experimental purposes. The price of the two aircraft was included in the £4,000,000, but the Minister explained that this figure does not cover the cost of basic research and wind-tunnel tests.

CANADIAN DISPUTE

THE request from the Governor of New York, Mr. Dewey, for State Department intervention in the dispute between Colonial Airlines and the Canadian Air Transport Board has been rejected by the State Department. The view was expressed that the State Department could not intervene in Canadian proceedings against an American airline company, since it could not interfere with the judicial processes of a foreign country.

Colonial Airlines had been ordered by the Canadian Government to show cause why their certificates to operate the New York-Montreal and Ottawa routes should not be revoked. Under an agreement signed between the two Governments last June, it was agreed that T.C.A. should share the Montreal-New York route, which had previously been the monopoly of Colonial Airlines, and rights in Canada were given to various American companies. Colonial Airlines brought an action in the American courts challenging the constitutionality of the agreement and, as a result, T.C.A. has been unable to com-

CIVIL AVIATION NEWS

LEVEL LOADING: Introducing new ideas in air-freight handling, the model freight terminal shown was designed by Lockheed Aircraft Corporation's sales engineer. It incorporates extendable and movable cargo ramps which permit direct loading and eliminate the need for accurate positioning of the aircraft.

mence operations on these routes. The American company asserts that the Montreal-New York route is the only profitable one which it operates and, that if competition by T.C.A. is allowed, it will have to curtail other services. Mr. Dewey has justified his request with the opinion that any cessation of Colonial Airline services in New York State would injure the commerce and transportation of the State generally. He considered that the action of the Canadian Air Transport Board was arbitrary and directly opposed to the interests of the communities served by Colonial Airlines.

Some American senators are said to have objected strongly to the State Department's action and that the chairman of the Senate Judicial Committee has called the Canadian step "a retaliatory action which cannot be tolerated by the United States Government." An observer is being sent to report on the proceedings of the action.

RADIO SHOWROOM

WITH the object of demonstrating and explaining the workings of aircraft radio aids, Airwork, Ltd., has opened a radio showroom in the terminal building at Gatwick Airport. All types of equipment in current use are being displayed and operated. Prospective customers having little or no knowledge of radio, may have detailed explanation and comparison of the various types of equipment, together with advice on the best methods of installing the appropriate units in their aircraft.

BREVITIES

AT the invitation of the Scottish Advisory Council for Civil Aviation, *R.M.A. Caledonia*, flagship of B.O.A.C's Stratocruiser fleet, will be officially named by Lord Pakenham at Prestwick on January 7th.

* * *

F.A.M.A., the Argentinian airline, has applied to C.A.B. for permission to operate a regular service between Buenos Aires and New York. Permission is likely to be granted for a period of six months, by which time a new bilateral transport agreement may be in effect between Argentina and the United States: the airline's concession would then be extended automatically.

* * *

In addition to her assessment as a member of I.C.A.O., Canada is contributing to the operations of that organization at the rate of $63,000 a year in the form of lowered rental charges on the I.C.A.O. headquarters building at Montreal. This "cost rental," it is believed, has been agreed for a period of 20 years, the customary procedure for countries in which such international bodies make their headquarters.

* * *

The Canadian Department of Transport announces that the trans-oceanic air-traffic control headquarters will be transferred from Moncton to Gander, with effect from April 1st. The transfer is a direct result of the Confederation under which Newfoundland now becomes Canada's tenth province, thereby making Gander the closest centre from which trans-Atlantic traffic may be directed. Headquarters for domestic air-traffic control in the Maritime Provinces will remain at Moncton.

* * *

It is claimed that more than 17,000 passengers have flown on the Stratocruiser Clippers of Pan American World Airways during the six months ended December 2nd. Of this total, 12,000 were carried on 275 trans-Atlantic flights to London or Frankfurt and the remainder on the New York-Bermuda run. Since the fleet of Stratocruisers began their trans-Atlantic duties on June 2nd they have accumulated some 45,800,000 passenger miles and approximately 1,120,000 aircraft miles.

* * *

Philippine Airlines' DC-6 flight which left London for Manila on November 23rd, is reported to have broken the flight-time record on this route by taking 31 hr 20 min; the scheduled time is 34 hr 30 min. The line operates a weekly DC-6 sleeper service to London and Manila, via Madrid, Rome, Lydda, Karachi and Calcutta, and from Manila, a bi-weekly DC-6 service to San Francisco via Guam, Wake and Honolulu; a DC-4 service is also flown from Manila to Hong Kong and Tokyo.

C.A.B. announces that parties organized under educational, religious or charitable auspices may, from June to September next year, fly the Atlantic at approximately half fares.

* * *

Situated at Kulayat, near Tripoli, Syria, the first Lebanese airport capable of receiving four-engined aircraft has been opened by the Premier, Riad el Solh.

* * *

Negotiations are in progress between the governments of New Zealand and Canada for an agreement which will include New Zealand in the operations of a Canadian air service to the South Pacific. The negotiations are believed solely to concern the responsibility of providing certain flying aids and facilities, and no great obstacles are anticipated.

* * *

Air France will fly no London-Paris services on Christmas and New Year's Days. Four supplementary services will be operated on December 23rd, 27th, 28th and 31st, all after 1930 hr. On the London-Riviera service the Sunday flights which would normally be made on December 25th and January 1st will be flown on December 23rd and 30th respectively.

* * *

The firm of Mitchell, Cotts and Co., Ltd., will in future represent Cyprus Airways on the Baltic Exchange. The arrangement will be a reciprocal one whereby the airline will offer freight as well as aircraft, and it will therefore assist the current policy of placing charter business on a sound economical basis by offering regular "backloads" from Africa and the Middle East.

* * *

The mountain-studded South American republic of Colombia, which claims to have operated the first commercial airline and to have introduced the first airmail stamp in the western hemisphere, celebrated the thirtieth anniversary of its national airline, Avianca, on December 5th. Avianca commenced operating in 1919 with two four-passenger, single-engined Junkers F-3s, and during the first year carried only 12 passengers. To-day it has a fleet of seven DC-4s and 30 DC3s, and last year carried 61,000,000 lb of freight.

* * *

It has been estimated that United States internal airlines will show a net profit of $17,000,000 (£6,000,000) for 1949. During the first nine months of the year the ten major airlines made a net profit of $16,339,000 (approximately £5,750,000) as compared with a net deficit of $7,220,000 (about £2,570,000) for the corresponding period of last year. According to the

CIVIL AVIATION NEWS . . .

Air Transport Association of America, airlines were responsible for 39.7 per cent of the first-class-travel market and accounted for some 3,790,995,000 passenger-miles as compared with the railway Pullman total of 5,748,788,560 passenger-miles. It has been predicted that next year the proportion achieved by the airlines may be as much as 46 per cent.

* * *

More than 200 round-the-world air tickets have been booked by B.O.A.C.'s tours section in London since the scheme, which provides links with other airlines covering the route, was introduced last April.

* * *

The appointment has been announced of Mr. Edwin Lloyd Greensmith as the sixth director of British Commonwealth Pacific Airlines, Ltd. Mr. Greensmith, who is Assistant Secretary to the New Zealand treasury, will represent New Zealand on the B.C.P.A. Board. His appointment follows a decision to increase the Board from three to six members—two directors from each of the shareholding countries.

* * *

Delegates to the I.A.T.A. Traffic Conference, which recently met in Mexico City, will, by the time they have returned to their homes in some 26 countries, have flown more than 994,200 miles—the equivalent of more than 20 times the circumference of the world at the equator. In recognition of his having travelled the greatest distance of any of the 120 delegates, Mr. William B. Pratt, of South African Airways, who travelled 12,496 miles from Johannesburg, was appointed honorary commandant of the Mexico City Airport for a day.

* * *

Following the recent reorganization of Air France in Central and West Africa, two new local services commenced on December 7th and 10th, the first being from Dakar to Abidjan and the second the Dakar link with Bissao. A third modification in the West Coast network was introduced on November 15th, when a twice-weekly service between Dakar and St. Louis was inaugurated.

* * *

Awards have now been announced by the General Claims Tribunal under the Compensation (Defence) Act, 1939, for the claims against the Air Ministry by three aviation companies owned by Mr. E. L. Gandar-Dower, M.P. Originally the claims amounted to approximately £9,000 per annum from the date of the requisition of Dyce airport in 1939, but during the course of the hearing they were reduced to approximately £5,000 per annum. An award of £1,500 per annum was made in respect of the major claim by Allied Airways (Gandar-Dower), Ltd., for an annual sum of £3,500.

FROM the CLUBS

NOW recognized as a classic among flying-club dinner-dances held in London, the Herts and Essex Club function this year more than fulfilled the expectations of the 300-plus guests. The Chief of Air Staff designate, Air Chief Marshal Sir John Slessor, G.C.B., D.S.O., M.C., honoured the Club with his presence, and in proposing its toast referred to an excellent record of licences obtained and the magnificent contribution by its pilots to the world war effort. Sir John said that it would be a disaster if such clubs had to shut up and, in fact, it was of great importance that they be kept going.

The chairman, Mr. Geoffrey de Freitas, M.P., Under-Secretary of State for Air, responding, said that the club had had a highly successful year, although the hours flown had not been so great as previously. This was due to expense and not lack of keenness. Mr. de Freitas added, significantly, that the Government were "not unhopeful that they may be able to evolve some scheme which will benefit not only the flying clubs but your very great Service, the R.A.F."

After the brief speeches there followed entertainment and dancing, everyone obviously being in remarkably good spirits. The dinner committee, under the chairmanship of Mr. V. A. Ercolani, is to be congratulated. Incidentally, the club fleet at the airfield at Broxbourne comprises at the present time five Tiger Moths, three Auster Autocrats, one Proctor, one Hornet Moth and two Rapides.

FIVE-SHILLING AUSTER: The presentation of the C. of A. for the Auster Autocrat which, as reported in *Flight* last week, was won by Miss Margaret Kelly of the Liverpool Flying Club, is the reason for the happy smiles of the recipient; she is seen at White Waltham with the chairman of the Association of British Aero Clubs, Mr. G. H. M. Miles, and S/L. Porteous of Auster's.

THE Oxford Aeroplane Club is making a special effort to increase its strength, and to this end a scheme suggested by a member has been adopted: each existing member is presented with a book of six membership applications; when he has sold all six he receives half an hour's free flying. A new committee was recently formed, with Mr. H. J. Curtis as chairman.

A programme of social activities has been arranged in which every Saturday evening will be an official club night and the first Saturday in every month an "at home" combined with a guest night, when it is hoped, some important personage may give a talk to as large a gathering as possible. The first "at home" of this new series was held on December 3rd, when the club was fortunate in having Mr. Peter Scott—who, incidentally, is also a member—to describe the Arctic trip from which he has just returned. A film of the expedition was shown during the very enjoyable evening. The club and airfield generally will be closed during the Christmas period, from Saturday until Wednesday, and no service or refuelling facilities will be available to visiting aircraft.

* * *

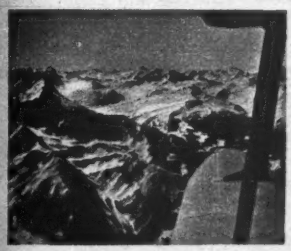
THE Thames Valley Flying Group, which was formed last year with the intention of operating a light aircraft under a communal ownership scheme, is being re-formed in conjunction with the Wycombe Flying Club, and the two Austers owned by that club will now be used. Members with previous flying experience will be accepted, and anyone joining may commence flying immediately. There is no entrance fee, but an annual subscription of one guinea is charged. Hire rates are £1 16s or £1 10s on prepayment of £10. Aircraft may be hired for a day or for longer periods at low rates.

The present operating base is the airstrip at Bourne End, near Maidenhead, but negotiations are in progress for the use of permanent quarters on an airfield nearer London. Prospective members should contact Mr. David F. Ogilvy at 9, Imperial Road, Windsor, Berkshire.

* * *

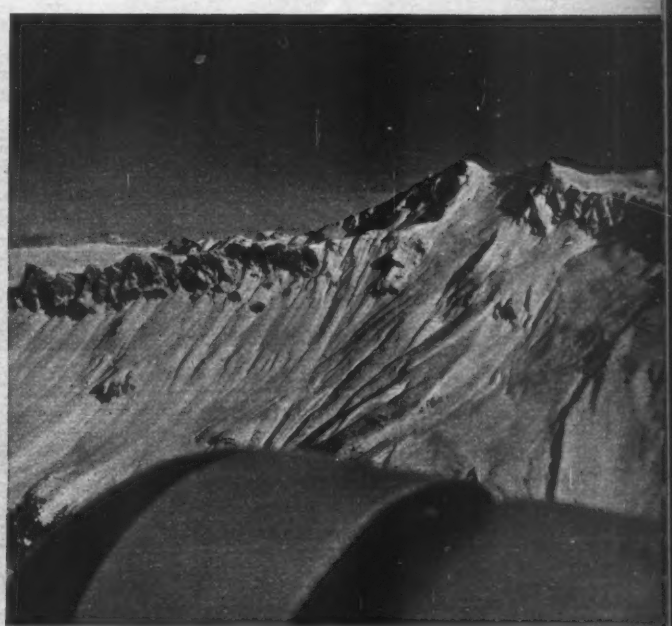
WITH the news that Fairwood has been finally de-requisitioned and is to be handed back to the Swansea Corporation, members of the Swansea and District Flying Club are now looking forward to the prospect of seeing the airfield become once more the centre of flying activity. Since the R.A.F. left the airfield early in 1947 continuous representations have been made to the Air Ministry and to the M.C.A. requesting the use of the airfield for private flying. No permission was forthcoming, however, and the buildings have now fallen into a very bad state of repair.

In spite of this discouragement, local enthusiasts are keenly interested, and a flying club was formed last July. There is now a long list of members, and it is hoped that flying will commence shortly. The secretary is Mr. G. H. Metcalfe, A.C.A.; his address is Barclays Bank Buildings, Wind Street, Swansea.



Whenever anyone deals with man's earliest attempts to fly, Messrs. Dædelus and Icarus inevitably head the list, but never, within our recollection, has anyone dilated upon the aeronautical ability of Father Christmas. By comparison with the feats which he annually performs, the efforts of Icarus and, indeed, those of mortal man, appear mundane in the extreme, for this pioneer freighter-pilot not only flies without aerofoil aid, but also contrives to carry an enormous payload; and, furthermore, he has the highly confusing ability to navigate entirely on good wishes and be in innnmerable different places at the same time.

Quite apart from his unique prowess as an aviator, Father Christmas epitomises man's annual festival of happiness when, for a little, the trials and struggles for material gain are put aside and instead, the warmer grace of good fellowship holds sway. It is in such a seasonable spirit that "Flight" sends greetings to its readers throughout the world.

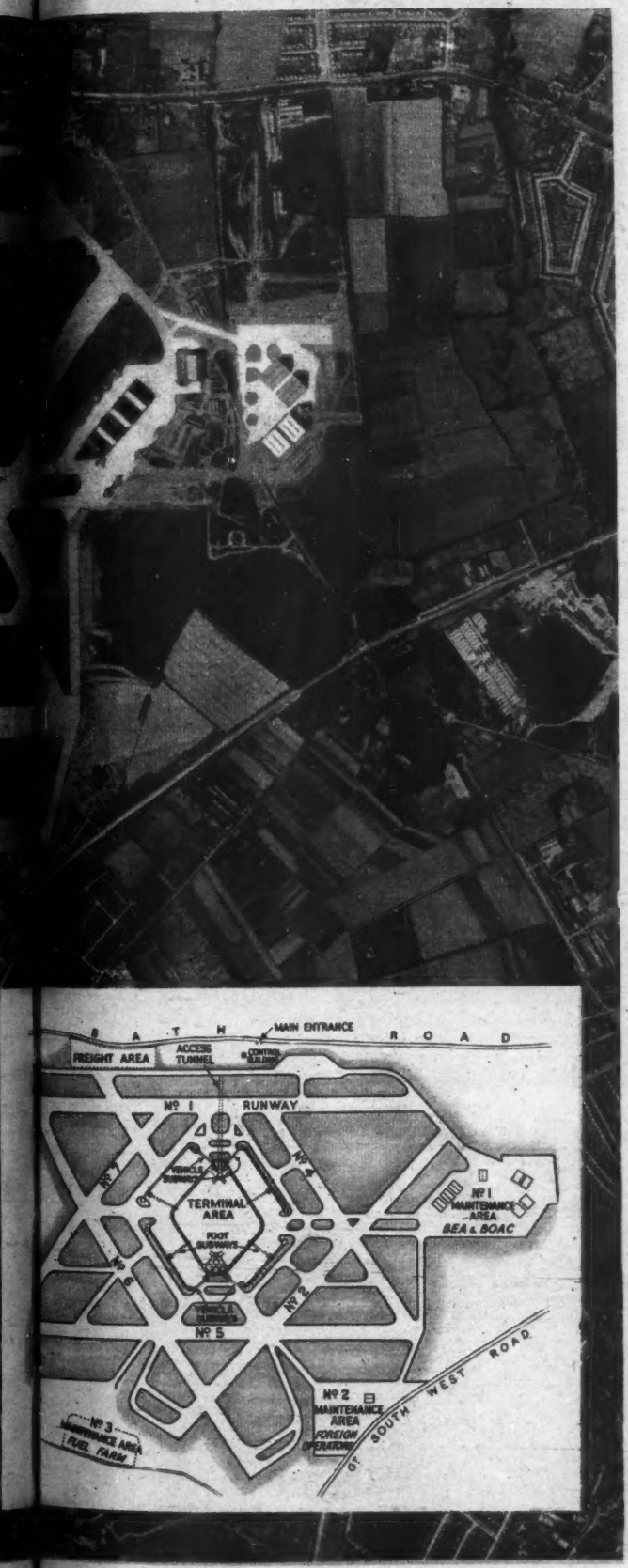


NIGHTMARES FOR NAVIGATORS

ARE you a good navigator? Do you know the wood from the trees, and can you tell a bitumenized runway from a nationalized railway? Good! But when your puzzled pilot, peering down at scenery like this, asks: "Where are we? What on earth's that?"—have you a set of safe answers? The right ones (upside-down to prevent cheating) are on the opposite page. Aerofilms provided the pictures.

(1) Seal-tracks on the Goodwin Sands. (2) Beer garden—a Kentish hopfield. (3) Water channels on mud-flats in the Middle East. (4) Log-rafts, Sault Ste. Marie, Michigan. (5) Mud-bank, Weston-super-Mare. (6) Preparing the ground for potato-planting, Hertfordshire. (7) More mud-flats in the Bristol Channel. (8) "I thought my blankets were white until I saw Pte. Pullthrough's"—Army laundry at Hayle, Surrey.

Air Survey Co. Ltd.



LONDON AIRPORT PROGRESS

Second Stage of Development Now Well Advanced

PROGRESS in the second stage of the construction of London Airport is now in an advanced stage, and in the adjacent aerial photograph the extent of concreting on runways and aprons can be clearly seen. Two of the runways in the original R.A.F. triangular system (Nos. 1 and 2), together with runway No. 6, now form the arrangement in current use (No. 6 having been put into service in June of this year to replace No. 3, which is now being broken up). Work on the four other runways in the original plan is now nearing completion. The construction of the fourth (No. 7) was found necessary in order to clear the future terminal area, across which No. 3 formerly stretched.

The plan calls for a main entrance tunnel leading from the Bath Road to the terminal area, through which all passenger and vehicular traffic will pass, and this consideration, plus the installation of an up-to-date lighting system and the completion of the junction with Nos. 4, 6 and 7 runways, requires that No. 1 runway shall be taken out of service. The subway is being cut and roofed-in rather than tunnelled underneath the runway itself. Runway No. 5 (3,150yd long and now almost completed except for a small section at the western end at the junction with No. 7) will then be put into service as the main runway. This work is scheduled for early 1951. Runway No. 1 is 3,000yd in length and No. 2, 2,000yd; four runways will be 300ft wide and the remaining two (Nos. 4 and 7) will be 250ft. Runway No. 4 is now only used for parking purposes.

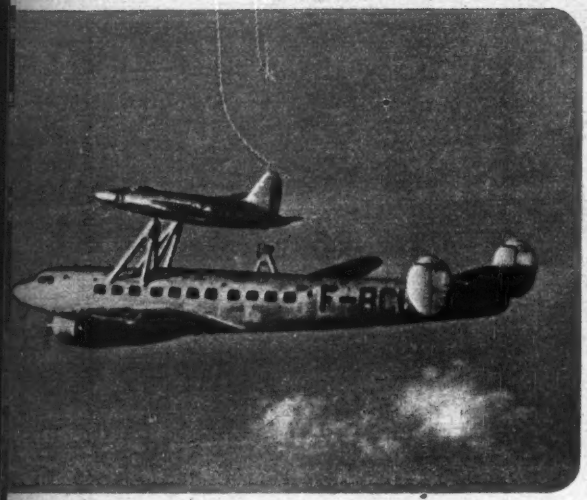
In order to achieve the present arrangement of the runways the diversion of two rivers and construction of two sections of road was necessary. The final layout, which permits two parallel runways in one direction to be used at the same time, should be completed by 1952, and the complete future plan is indicated in the key diagram to the aerial picture.

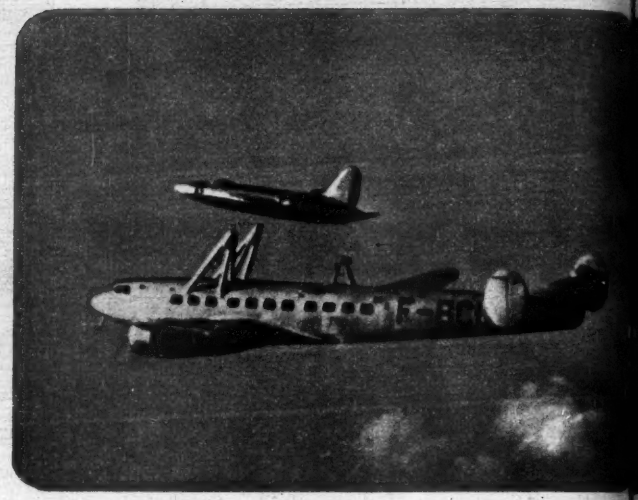
The concrete aprons, providing hard-standings on the eastern facets of the central diamond, are now almost complete and a series of vehicular and pedestrian subways are being cut to connect the terminal area with the aircraft parking areas, thereby eliminating the necessity for the dangerous intermingling of walking passengers, mobile vehicles and taxi-ing aircraft on the parking aprons. The plan envisages eight such subways, on which work is now in progress; their positions are indicated on the diagram.

The terminal buildings at present used will eventually be replaced by those of semi-permanent, two-storey type, which will be erected in the central area. No permanent buildings have as yet been planned, but the eventual layout is thought to depend largely on the experience gained in the period during which the semi-permanent constructions are used. The construction of a permanent control tower is also in the immediate plan for the central area.

The airport now has a total of four hangars on No. 1 maintenance site, and four others are now being built. The single, large hangar used by Pan American Airways, which has been constructed on No. 2 maintenance site, was shipped from the U.S.A. and erected under local arrange-

(*Concluded on page* 804)





SHORT-MAYO "COMPOSITE" RECALLED

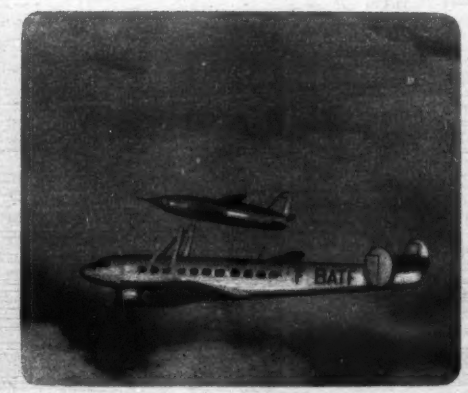
French Research Aircraft Air-launched from Languedoc

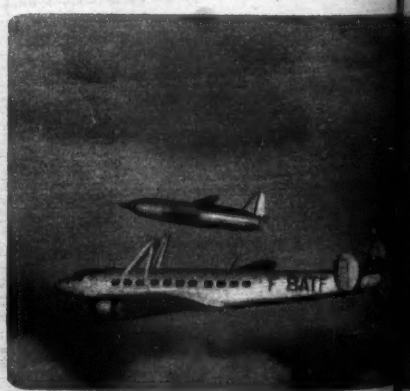
PARALLEL French research projects, launched from adapted S.E.161 Languedoc transport aircraft, the Leduc 0.10 (above) and the S.O. M.1 (below) depicted in these frames from British Paramount News, evoke memories of the pre-war Short-Mayo "Composite." The Leduc machine has been built for the investigation of ramjet propulsion and the S.O. M.1 is a glider model of the S.O.4000 twin-Nene bomber, a feature of which will be armament mounted at the wing-tips.

Outcome of pre-war proposals, the ramjet installed in the 0.10 develops some 3,500 lb thrust and is designed to achieve speeds approaching 600 m.p.h. The first launch from a Languedoc was made late in 1947, but on that occasion the power unit was inoperative. On the first powered flight a speed of some 450 m.p.h. was reported to have been attained, using only half thrust.

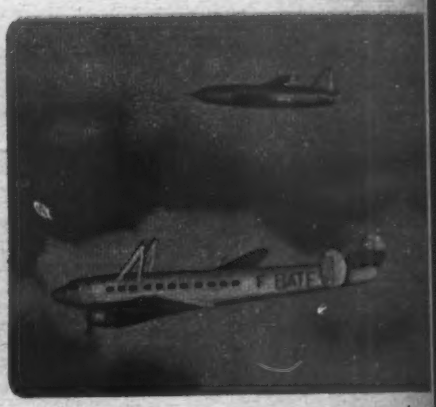
Fully laden, the S.O. M.1 weighs over 6,000 lb. The span is 34ft 6in and the wing area 172 sq ft.

The S.O. M.1 is a pure glider and was first launched in March, 1948. A powered version, designated S.O. M.2, was displayed at the last International Aeronautical Salon in Paris and is fitted with a single Rolls-Royce Derwent 5. For high-speed flying the transparent cockpit roof of this model is flush with the top fuselage line, but during a normal take-off and landing a small windscreen can be raised, in conjunction with the pilot's seat. Three main wheels retract into the fuselage; there is a conventional retractable nosewheel and auxiliary, jettisonable, wing-tip wheels. As on the "M.1," the ailerons are amazingly small, but are interconnected with spoilers to provide lateral control. The S.O. M.2 first flew on April 13th this year. Its fully laden weight is 8,400 lb, and the span 29ft 9in.





The Leduc 0.10 positioned on its parent Languedoc



North American T-28—the first tricycle trainer for the U.S.A.F. This view shows the large size of the bubble canopy and the small size of the pilot in relation to the engine and fuselage. North American Aviation, Inc., have 268 on order for the U.S.A.F.

U.S.A.F. TRAINER AIRCRAFT

A Design Review of the Post-war Tutorial Stable

By STANLEY H. EVANS, F.R.Ae.S., A.F.I.Ae.S.

LOOKING back over the past year or so, a broad landscape view of U.S. Air Force trainer trends is now possible and a design comparison can be presented within the two-seater piston-engined group comprising the North American T-28, Douglas XT-30 and Fairchild T-31. Two private-venture designs, the Beech T-34 and Temco T-35, are also worthy of note.

The new "T" designation now embraces the whole range of Air Force trainer aircraft, in place of the earlier subdivisions of PT, BT and AT for primary, basic and advanced types. It also includes trainer aircraft in the twin-engined category such as the Convair T-29, intended for twin-engined pilot and navigator training, so it will be fitting to finish up in the classroom with a brief look at this aircraft.

NORTH AMERICAN T-28

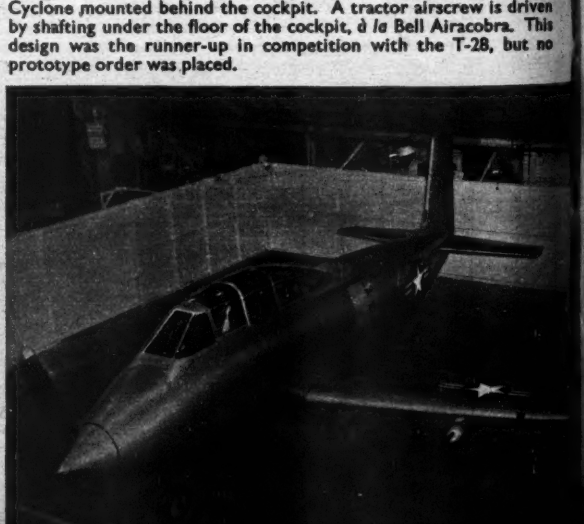
Winner of an industry-wide U.S.A.F. competition for an all-purpose tandem two-seater trainer, the first of a production batch of 268 T-28s recently completed its initial flight-tests. The T-28 was planned as a combination primary-basic-advanced trainer to qualify pilots from the tyro to the advanced stage in readiness for the transition step to jet fighters. The final step between piston and jet will be met by the new Lockheed TF-80C, the two-seater version of the F-80 Shooting Star. (The TF-80C—described in *Flight* of May 6th, 1948—has now been re-tagged the T-33.)

That, at any rate, was the original idea behind the T-28, but since the specification was laid down there seems to have been a change of heart or training philosophy, possibly influenced by the Navy's voice in the unification programme. Not unexpectedly, perhaps, the 800-horse stable of the T-28 has been questioned as a bit of a handful for the neophyte pilot to hold under rein, and so recently the Air Force placed an order for 100 Fairchild T-31 primary trainers while engaged in further co-ordination of the joint Air Force-Navy training programme. The T-31 was originally designed as the XNQ-1 for the Navy and will be discussed in turn.

With one important exception, the T-28 follows the conventional design pattern of N.A.A.'s previous series of trainers from the original NA-16 right on up the family line to the ubiquitous AT-6 Texan used by so many Air Forces during and since the war. (This company has been in continuous trainer design and production since its incorporation in 1934 and has produced over 20,000 trainers for U.S. and other customers.) The most noticeable external difference is the nosewheel landing gear, steerable from both cockpits through an electro-hydraulic boost control. This is, in fact, the first time that a tricycle gear has been written into a U.S.A.F. trainer specification, and in view of the end result being sought—the pilotage of jet fighters and bombers—such a design requirement is mandatory for an advanced trainer. (The case for this type of landing gear is not, perhaps, quite so clear-cut for primary trainers.)

But looking beneath the skin of the T-28 there can be little doubt that the major design-feature that influenced its selection by the Air Force was the ease of access for maintenance on the flight line, bearing in mind the hamfisted hammering that befalls the military trainer, day in and day out. This built-in design philosophy—it is really the underlying theme rather than any single feature—reduces both the mechanic personnel and the time required in keeping the aircraft serviceable. For instance, a mechanic can work on the rear of the engine without open-

Airframe mock-up and operational engine test-bed of the proposed Douglas XT-30 all-purpose trainer powered with an 800 h.p. Wright Cyclone mounted behind the cockpit. A tractor airscrew is driven by shafting under the floor of the cockpit, *à la* Bell Airacobra. This design was the runner-up in competition with the T-28, but no prototype order was placed.



U.S.A.F. Trainer Aircraft . . .

ing up the cowl panels, by stepping up on a built-in stirrup to an access-port on the underside of the engine bay and then unsnapping a metal plate in the firewall. In this way he can make adjustments on the flight line and he is protected from the "prop wash" while the engine is turning over.

The automobile-type cowling allows complete accessibility to the engine and one man can operate either one section or all four panels together. Engine and oil system can be removed and replaced by two men in 45 minutes. Armament, gun-sight, radio and similar gear can be easily installed or removed, due to special "package" design which permits unit maintenance. The outer wing panels can be removed without breaking the aileron cable system. Horizontal stabilizer panels are identical and, along with the vertical fin, can be removed independently of one another in ten minutes by a couple of men. The elevators and the trim tabs are also interchangeable from one side to the other by inverting them.

So much for the mechanic's viewpoint. Pilots looking at the cockpit interior will be equally impressed with the simplification that has been achieved in the T-28. Gone is the assortment of boxes and paraphernalia that housed the radio equipment in earlier models, for the bits and pieces have been cleaned up and relocated in a logical and orderly pattern. Radio and electronic equipment includes a V.H.F. command set, range receiver, marker-beacon receiver, interphone system, radio compass, and instrument landing system.

Complete flight controls and instruments are located in both cockpits, with special lighting on the instrument panels to enable students to use the Air Force "view-limiter" for blind flying. Both fluorescent and incandescent lighting with rheostat control permits selection of the proper amount of cockpit light. When used for instrument flight training, the front cockpit is occupied by the instructor, who also has, under his command, controls for simulating flight-instrument failure for emergency procedure practice. The instruments are arranged in tilted panels for easier reading, while, for quick identification by touch, the flap and landing-gear handles are shaped to resemble the units they control.

A nosewheel landing-gear is a useful safeguard against the "nose-over" hazards common to flight training, and the accompanying tail-up virtue of being able to see over the nose cowl while taxying and taking-off provides an extra safety measure. (We speak from the heart, as a tarmac tyro who once taxied full-tilt into a fence!) The nose slope in the T-28 amounts to 12½ deg and, although this is an improvement over the Air Force's "handbook requirement" of 11 deg, it still points up the penalty inherent in the installation of a 50in "chrysanthemum" in the nose—the truth being that a big radial engine is entirely unsuited to the tandem-cockpit layout.

Since, moreover, this type of high-powered trainer is the step-ladder to the jet fighter, it is fair to assume that the T-28 will be the last of the conventional piston-engined advanced trainers for the U.S. Air Force or Navy. Following current British practice, its logical successor will almost certainly be turbopropped—in which case the cowl lines can be more easily designed to lend enchantment to the view.

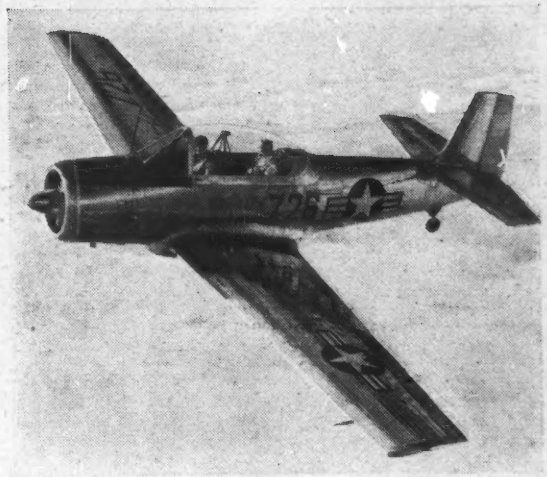
NORTH AMERICAN T-28

Power Plant.—Engine : Wright R-1300-1 7-cylinder radial ; normal rating 700 h.p. at 2,400 r.p.m. at 5,000ft ; take off power (s.l.) 800 h.p. at 2,600 r.p.m./Airscrew : Aero Products constant-speed, two-bladed, 10ft diameter. Tankage : fuel, 125 U.S. gal.

Dimensions.—Span 40ft 1in ; length 32ft ; height 12ft 8in ; wing area 268 sq ft ; aspect ratio 6.0.

Weights and Loadings.—Gross weight (max. take-off) 6,759 lb (normal) 6,365 lb ; weight empty 5,111 lb ; useful load 1,648 lb ; wing loading (normal) 23.8 lb/sq ft ; power loading (take-off) 8.45 lb/h.p.

Performance.—Stalling speed 72 m.p.h. ; normal cruising speed 166 m.p.h. ; maximum speed 288 m.p.h. at 5,900ft ; initial climb 2,570ft/min ; service ceiling 29,800ft ; take-off run (50ft obstacle) 1,310 ft; maximum range 1,000 miles.



The Fairchild T-31, powered with a 295 h.p. Lycoming nine-cylinder radial, looks eminently suitable for *ab initio* instruction.

DOUGLAS XT-30

This design proposal (previously illustrated in *Flight* of December 30th, 1948) was the runner-up to the T-28 in the aforementioned design competition held last year. Although the design study did not materialize even as far as a prototype aircraft, it was considered promising enough to warrant further evaluation, and Douglas were given a half-million-dollar contract to build an experimental mock-up. Perhaps, however, the term "mock-up" does the construction seen in the accompanying illustration less than justice, since in reality it amounted to a fairly complete operational power-plant test-bed to work the bugs out of the submerged engine, with remote airscrew drive, which was the backbone feature of the design.

The basic design concept of the XT-30 was a two-seater revival of the Bell P-39 Airacobra formula, wherein the engine is completely buried at mid-fuselage immediately aft of the rear cockpit and over the rear portion of the wing root, the tractor airscrew being driven by an extension shaft under the cockpit floor. An obvious advantage of such a scheme is that, since the engine weight is shifted aft, both tandem seats can be located forward of the wing, thereby giving the occupants an unobstructed forward and downward view over the sharply tapered nose—the kind of view, in fact, that one properly associates with the jet fighter.

Compared with the orthodox approach exemplified in the T-28, there can be no gainsaying that the XT-30 layout lends itself to a much better (and, therefore, safer) view for both student and instructor; also that the aerodynamic configuration of the fuselage is markedly superior because of the finer nose-entry and the higher propulsive efficiency of the body-airscrew combination. Another good feature that logically follows from the rear-engine installation is the longer wheelbase of the nosewheel tricycle landing gear—again the sort of thing that ties in with jet-fighter landing technique and ground-stability characteristics.

From the maintenance standpoint, Douglas engineers claimed that the midship power plant lent itself to improved

Cockpit concerto: The functional harmony of the T-31 cockpit layout is clearly shown in these right- and left-hand interior views of the control panels. The flap and landing-gear lever handles have characteristic shapes.

U.S.A.F. Trainer Aircraft . . .

accessibility of engine and accessories, but on the face of it this seems a bit harder to justify. Admittedly, a six-man maintenance crew had been timed to remove and install an engine in slightly over 20 minutes; however, we suspect that a six-man engine crew for a two-seater trainer would be looked at askance by commercial school-operators. A possible answer might be found in designing the rear half of the fuselage with detachable joints aft of the engine bay, following jet-fighter construction again.

Judging from the view of the mock-up, the XT-30 would have been a clean, square-cut, straightforward low-wing job with a span of 36ft 4in, length of 36ft 10in and overall height of 13ft 7in. The submerged engine was an 800 h.p. Wright R-1300 radial, similar to that installed in the T-28, hence the maximum fuselage-width must have been at least 4ft 6in in the region of the rear cockpit. Cooling, we believe, was arranged through an air scoop on the underside of the nose cowling. Incidentally, looking at the long fuselage nose and bubble canopy forward of the c.g., one cannot help feeling that the vertical tail geometry is shy on dorsal finning.

Estimated performance was a top speed of 286 m.p.h. at 10,000ft, a cruise speed of 190 m.p.h. for 6¼ hours, and a service ceiling of 29,600ft. A picturesque gross weight of 5,999 lb was also quoted, a figure which may be taken as an impressive token of the weight guestimator's art, seeing that the power plant alone (not to mention the rest of the equipment supplied from outside sources) could vary as much as plus or minus 10 lb. Furthermore, since the T-28 is now quoted at 6,759 lb, it is tolerably certain that the XT-30, with its remote airscrew drive, would have scaled something over the 7,000 lb mark—which, no doubt, is impressive hindsight on *our* part!

Because the airframe designer must perforce make the best of existing power plants within the desired power range, it is no reflection on either the T-28 winner or the XT-30 runner-up to say that they both suffer from the handicap of trying to mate an overgrown seven-cylinder radial engine of 50in diameter with a two-seater tandem cockpit layout, resulting in a body width at least 50 per cent greater than is really necessary or desirable for aerodynamic and vision requirements. Perhaps this sort of excess elbow-room may be more pardonable at the high-powered advanced stage of training, but it strikes us as a bit awe-inspiring for the raw recruit. Indeed, it rather reminds us of the first time we were persuaded to straddle a horse—we were amazed at the enormous expanse of the beast in plan view!

Doubtless it is better to have the chrysanthemum behind, rather than in front of one's face, but nevertheless the submerged-rear-engine scheme is a belated attempt to make the best of the existing engine situation at the expense of engineering complexity, weight and cost. A dozen or so years ago the Bell fighter layout appealed to us very strongly as an outstanding design concept but, to-day, in view of the rapid advance of the turbine art, the logical answer for the pre-jet trainer is obviously the small-diameter turboprop engine on the lines of the A.S. Mamba or the R.R. Dart. We suggest, though, that the power required might be trimmed back to 500 or 600 s.h.p. for a tandem two-seater layout.

FAIRCHILD T-31

As mentioned earlier, the T-31 started out as the Navy XNQ-1, being the winner of a design competition for a primary-basic trainer sponsored by the Bureau of Aeronautics. Invitations to bid were also extended to Beech, Boeing, Bell, Convair, Curtiss-Wright, McDonnell, and North American. As a matter of record, the Navy XNQ-1 prototype was first flown as far back as October, 1946, flight evaluation tests being conducted by the Navy throughout the following year. Although no production contract resulted on the naval side, the Air Force became interested in it as a primary trainer and further flight tests were continued at Wright Field last year. Early this year Fairchild received an $8,000,000 U.S.A.F. contract for 100 aircraft plus spares, and primary flight training on T-31s will commence early next year.

A study of the T-31 shows a conventional, square-cut, low-wing tandem two-seater in the 300 h.p. class, with a tailwheel landing gear configuration, large one-piece bubble canopy, externally hinged slotted trailing-edge flaps, and stressed-skin construction throughout—except for the control surfaces, which are fabric-covered. Illogically, perhaps, from the standpoint of lateral control effectiveness, the ailerons are not slotted, although they appear to have a modest degree of nose balance. Only the main wheels are retractable, folding inboard into housings forward of the front spar at the junction of the wing with the fuselage, the retraction mechanism being electrically operated.

The engine is a Lycoming R-680-13 nine-cylinder radial with a normal rating of 280 h.p. and 295 h.p. for take-off. Engine cooling air and exhaust gas are taken out through louvred grilles around the sides and bottom of the cowling, leaving the top cowl panel flush and the windshield unobstructed by oil smudge. The Hamilton-Standard constant-speed airscrew has the blade roots neatly faired off with a fair-sized hub spinner. This latter refinement is conspicuously absent from the T-28, where its effect on blade efficiency might have been considered even more beneficial.

Undoubtedly the most advanced design feature of the T-31 is the functional layout of the cockpits, wherein the characteristic shape of the aircraft part or unit (e.g., wing flaps, landing gear, etc.) is reflected in the shape of the corresponding control-handle in the cockpit; thus, the flap lever handle is shaped like an aerofoil element, the landing gear retraction lever knob is patterned after a wheel and tyre, and so on. Engine controls are grouped on the left side and all the electrical switches are neatly ranked on a console on the right. The radio equipment is also neatly tucked away on the right side. Instruments are illuminated by indirect red lighting for night flying, with the flight instruments arranged in the centre of the panel, enclosed by a white boundary-line, and the other instruments grouped around them.

FAIRCHILD T-31

Power Plant.—Engine : Lycoming R-680-13 nine-cylinder radial ; normal rating (s.l.) 280 h.p. at 2,200 r.p.m. ; take-off power (s.l.), 295 h.p. at 2,300 r.p.m. Airscrew : Hamilton-Standard, constant-speed, two-bladed, 8ft 3in diameter. Tankage : fuel, 80 U.S. gal (wing tanks) ; oil, 6 U.S. gal.
Dimensions.—Span 41ft 5in ; length 27ft 11in ; height 8ft 9in ; landing gear track 9ft 1in ; wing area 236 sq ft ; aspect ratio 7.25.
Weights and Loadings.—Gross weight 3,750 lb ; weight empty 2,817 lb ; useful load 933 lb (instructor and pupil, 400 lb, fuel 480 lb, oil 53 lb); wing loading 15.9 lb/sq ft ; power loading 12.7 lb/h.p.
Performance.—Stalling speed (3,500 lb) 56 m.p.h. ; cruising speed (65 per cent normal power) 142 m.p.h. ; maximum speed (s.l.) 166 m.p.h. ; initial climb 1,070ft/min ; service ceiling 19,500ft ; take-off run (over 50ft obstacle) 1,190ft ; maximum range 900 miles at 110 m.p.h. ; endurance 4.7 hours at 142 m.p.h.

BEECH T-34 and TEMCO T-35

Two other "private venture" primary trainers were built and flown during the past year or so in competition with the T-31, namely the Beech T-34 Mentor and the Temco T-35. A recent report—which must be taken with a large dash of salt—says that the Air Force may cancel the T-31 contract and re-examine the T-34 and T-35, but such a change of design policy at this late date seems hardly likely, despite the saving in cost to the taxpayer by reason of the lower power bracket of the two private venturers. Bearing in mind, however, the almost feminine changes of front and face of the Air Force over the past twelve months, it might be as well to complete the numerical record with a passing note on these low-cost trainers.

The Beech T-34 is a stressed-skin, tandem-seated, low-wing layout, powered (like the same firm's Bonanza four-seater personal aircraft) with a Continental E-185-1 flat-six engine delivering a maximum of 185 h.p. at 2,300 r.p.m. (It seems more likely that production aircraft would be fitted with the E-185-3 engine rated at 205 h.p. at 2,600 r.p.m. for take-off, since this later type engine is now installed in the 1949 Ryan Navion four-seater.) The airscrew is Beech's own design with an electrically controllable variable pitch and efficient-looking hub spinner.

Claims have been made that many of the airframe parts are interchangeable with those of the Bonanza, and so the T-34 could be offered to the Air Force in quantities for around $20,000 as against $50,000 for the T-31. In view of the fact that even a primary military trainer would have to be designed for aerobatic load factors, it is a bit difficult to see how much of the structure could be interchangeable between the two types, other than detail fittings and assemblies, perhaps. Certainly the slimmer fuselage and orthodox cruciform tail of the T-34 bear little structural resemblance to the wide, automobile-type body and butterfly vee-tail of the Bonanza.

All the same, the Beech contender has a number of excellent features in its favour. In spite of the modest power rating, the all-round performance is nearly as good as that of the T-31, although the latter has more range and endurance—albeit costing double the fuel consumption to get it. A good reason for the performance equality lies in the smaller wetted surface area of the T-34, which balances the slightly better wing-power loading parameter of the T-31. Two further points in favour of the Beech design are the fully retractable nosewheel-type landing gear and the better view over the low nose-cowling of the flat-type engine.

In passing, it might be said in this connection that if the prancing pistons must remain with us in the low-power category for some years yet, the best all-round engine partner is

unquestionably the inverted straight-six, as seen in the de Havilland Gipsy-Queen 200-350 h.p. series. Oddly enough, this was also the type developed by Fairchild's engine division, but now apparently abandoned. The queer thing, perhaps, is that both the Air Force and the Navy should have lost interest in this type of power plant for trainer aircraft.

The Temco T-35 follows much the same formula as the T-34, although it is still lower down the weight and power scales with a gross of only 1,840 lb and a maximum power of 145 h.p. It was developed by Texas Engineering and Manufacturing Co., of Dallas, from their well-known personal two-seater Swift model, and it has a similar tailwheel type of landing gear with the main wheels retractable. The claimed speed and climb performance strike one as a bit optimistic, while the small tankage and corresponding range are insufficient for a military trainer; moreover, the weight account—according to our budgeteering—cannot cover the requisite training equipment seen in the functional cockpit of the Fairchild T-31. Whereas the Beech T-34 might possibly be a serious rival for the hand (and pocket) of Uncle Sam, the T-35 looks right out of courtship.

BEECH T-34

Power Plant.—Engine : Continental E-185-1 flat six ; normal rating 165 h.p. at 2,050 r.p.m. ; maximum take-off power 815 h.p. at 2,300 r.p.m. Airscrew : Beech variable-pitch, two-bladed, 7ft 3in diameter. Tankage : fuel 39 U.S. gal ; oil 2.5 U.S. gal.
Dimensions.—Span 32ft 10in ; length 25ft 11in ; height 9ft 7in ; landing-gear track 9ft 7in ; wing area 178 sq ft ; aspect ratio 6.1.
Weights and Loadings.—Gross weight 2,650 lb ; weight empty 1,957 lb ; useful load 693 lb ; wing loading 14.9 lb sq ft ; power loading 14.3 lb/h.p.
Performance.—Stalling speed 56 m.p.h. ; cruising speed (60 per cent normal power) 160 m.p.h. at 10,000ft ; maximum speed 176 m.p.h. ; initial climb 925ft/min ; service ceiling 18,000ft ; maximum range 634 miles.

(The final section of this review, dealing with the Convair T-29, will appear next week.)

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

FARNBOROUGH FILMS

HERE in Australia we have recently seen the newsreels of the S.B.A.C. display, but the whole show is passed off in a few brief and confused minutes.

Each year Farnborough attracts teams of cameramen, but their week's work is cut and edited to the short time allowed on the public screens. Could not the S.B.A.C. collect the material together and issue an official film? Such a film would be of great interest to technical societies throughout the world and would also be a most interesting record for the years to come.

A. H. HAMMOND.

Melbourne.

BERMUDA AND THE COMET

AS one who has always had at heart the prestige of British aircraft abroad, and especially in the U.S.A., may I be permitted to outline what I believe to be a perfectly sound and feasible plan for the first two production Comets, which, all being well, will probably be delivered to B.O.A.C. some time in late 1951 or early 1952?

My idea is, briefly, as follows: Why not further enhance the prestige of Britain's undisputed lead in jet transports by putting the Comet *first* into service on one of the most lucrative dollar-earning routes in the world, namely, the New York/Bermuda schedules of B.O.A.C. which its predecessor, Imperial Airways (in partnership with Pan American) pioneered 11 years ago?

I firmly believe the New York/Bermuda schedule would be an ideal "practical showroom" to sell the many outstanding achievements and advantages of jet airliners to the vast numbers of airline travellers in the U.S.A. The distance involved, a mere 670 miles, would be well within the Comet's capabilities, with an interior layout for 36 passengers.

The present flying time between New York and Bermuda is, I believe, just over three hours, using Boeing 377s and Constellations. Cruising at an economical (?) 450 m.p.h. at 30,000ft, the Comet should well be able to maintain a schedule of 90 minutes on the Bermuda flights. Since it is fairly safe to assume Boeings and Constellations will be its only competitors for two or even three years (in the Americas), the Comet would indeed "steal the show" every time with those tens of thousands of American airline travellers who take their winter vacations in the Bermudas.

Glasgow. COMET ENTHUSIAST.

THE GLOSTER E.28/39

I READ with great interest the article by Robert J. Blackburn in *Flight* dated October 27th, concerning the Gloster E.28/39 prototypes. It reminded me of an incident which occurred on Friday, August 25th, 1944. I was at an A.T.C. camp at Westcott at the time, and, since the release of information on these aircraft, I have been convinced that one of the two machines did, in fact, land there on that day. Mr. Blackburn does not mention Westcott in his article. In view of this I wrote to the Gloster Aircraft Co., Ltd., and although they went to a lot of trouble they could not help me, as they had no records of flights made when the aircraft were not in the hands of their own test pilots.

Perhaps you or your readers can shed some light on this mystery. I shall be most grateful for any information you can obtain, leading to confirmation of the fact that an E.28/39 (presumably W4041/G) did indeed land at Westcott on that day.

G. R. WRIXON.

Hinchley Wood, Surrey.

OCTOBER AVIATION EXPORTS

IN a brief review of British aircraft exports for October, published in these columns on December 8th, certain figures were misquoted. The total value of aviation products exported was, actually, £2,087,882, while the value of the 75 complete aircraft sent abroad was £878,111. The figure for accessories should have read £646,478.

I.F.R. PRODUCTIVITY

SOME degree of control of known aircraft flying in I.F.R. conditions outside Control Zones and Areas has now been made possible by the introduction, with effect from January 1st, of a system known as Informative Control. Notice to Airmen No. 178 of 1949 contains full details of the arrangement, under which the Air Traffic Control Authority may provide an informative control service to ensure that adequate separation is maintained between aircraft flying in I.F.R. conditions.

"Known aircraft" are those which comply with the reporting procedure by which position reports containing nine separate points of flight information are transmitted on entering a flight-information region and at each subsequent 30-minute interval. Instructions given by Air Traffic Control will be passed as clearances and are required to be carried out as far as it may be practicable to do so.

Owing to the limited amount of information which will be available for control of traffic other than that which complies with the position-report procedure, a measure of discretion is left to the pilot in command as to whether or not he complies with any clearance received. A.T.C. centres will discontinue informative control in respect of any aircraft which notifies a change of flight plan from I.F.R. to V.F.R.

FORTHCOMING EVENTS

Jan. 24. R.Ae.S. (Belfast) : "Recent Development in Aircraft Production Engineering," by Prof. Connolly, B.E., F.R.Ae.S.
Jan. 28. Helicopter Association : "Pest Control and the Helicopter," by Dr. W. E. Ripper, F.R.E.S.
Jan. 28. Society of Licensed Aircraft Engineers : "Dowty Electro-hydraulic Systems," by Neville J. Horne.
Jan. 31. Society of Instrument Technology : "Continuous Gauging of Thread or Wire," by L. C. Evans, M. Groneck and H. G. Lee.
Feb. 1 Royal United Service Institution : "Aircraft for Army Uses," by Lt.-Gen. R. N. Gale, C.B., D.S.O., O.B.E., M.C.
Feb. 4. British Interplanetary Society : "Effects of Interplanetary Flight" (discussion).
Feb. 8. R.Ae.S. (Weybridge) : "Aerodynamic Consequences of Flying High and Fast," by W. G. A. Perring, C.B., F.R.Ae.S., A.M.I.N.A.
Feb. 8. British Interplanetary Society (Manchester) : Astronomical Observatory Visit.
Feb. 8. R.Ae.S. (Belfast) : "Rocket Propulsion and Interplanetary Flight," by A. V. Cleaver, A.R.Ae.S.

WEIGHT and DESIGN

Mr. L. W. Rosenthal's Lecture Before the Royal Aeronautical Society

IN *Flight* of December 8th was included a brief résumé of the lecture, *The Weight Aspect in Aircraft Design*, presented before the Royal Aeronautical Society on December 1st by L. W. Rosenthal, A.F.R.Ae.S., M.I.Ae.S., chief weight engineer of Saunders-Roe, Ltd. We are now able to give a more detailed abstract from this important paper, the first to have dealt exclusively with the subject of weight since that given by Major T. M. Barlow before the Society in 1929.

Mr. Rosenthal started by postulating that structural efficiency was only one component of weight efficiency and, in his opinion, was not necessarily the most important one. A more positive outlook toward the whole weight problem should be developed. Whereas, in the past, aircraft had been designed with the hope that they would be light, we ought now to set about *designing* them light. It was not just a matter of detail design, structural efficiency or even project design efficiency, but was, rather the whole approach to the problem.

Did a multi-engined flying-boat operating on a scheduled run between fully equipped bases and carrying liberal fuel reserves need to carry an anchor? inquired the lecturer. Was the growing practice of using engine cowlings as maintenance platforms, and flying with four sets of ground equipment continually on board really economic, or was it an easy way of coping with current design of engines, cowlings and ground equipment? Were up to ten instruments needed to tell a pilot that an engine was in trouble and must be shut down, or could perhaps one or two warning lights tell him the same thing? In general, Mr. Rosenthal thought that the matter of weight had not been taken really seriously and that only lip service had been paid to it, and he emphasized, therefore, that useful thinking time should constantly and consciously be devoted to the matter.

When designing anything but structures, the natural reliance had been on personal judgment of what was the lightest method of doing a job, and where no one could calculate the loads of size of gear required, it was safe to hide behind personal opinion. With the structure, however, where sizes were calculated, tests had proved that calculations, in general, had been pessimistic; and, because considerable scope for weight-saving existed in the structural field, the stress office had been made something of a scapegoat.

Power plant and equipment weight together comprised more than that of the structure group, and a one per cent saving on these would give the bigger dividend. It should be easier to save on pipe couplings, toilet fittings, tables and so forth than on, say, the spar booms or wing skin. The inconsistency of equipment weight was striking, and the lecturer had seen examples of equipment designed and manufactured by aircraft equipment specialists which, when re-designed to standard airframe practice, had weights reduced on an average by 60 per cent.

The Price of Lightness

The aircraft manufacturer wanted the lightest possible equipment, but was he prepared to pay for it and, if so, how much? How many airframe manufacturers were to-day prepared to say "on our 'so-and-so' aircraft, for every pound saved on proprietary equipment weights we will be prepared to meet additional costs up to £*x*"? Until someone did this, the accessory companies were in a dilemma with everyone pressing them to save weight, but with no idea of how much outlay they must make or what return they could expect. It was becoming a practice nowadays to include weight guarantee clauses in contracts for aircraft, and Mr. Rosenthal said he could not see how any airframe manufacturer could fail to make similar clauses in his sub-contracts, or to allow any sub-contractor to pay less attention to weight than he himself maintained.

The introduction of the gas turbine must have rendered obsolete all the previous weight experience gathered on reciprocating types and, obviously, the engine industry had had to start again. However, the engine people were definitely ahead of the airframe industry in the control of casting weights, and their procedures in this connection would well merit an investigation. The present practice in the airframe industry of buying castings by weight was surely an anachronism, since the foundryman was actually paid more money if he produced castings thicker and heavier than were, in fact, required.

In dealing with structure, the lecturer observed that there appeared to be two distinct and important factors involved: (a) Design efficiency, i.e., having the design so formulated that th loads to be carried were reduced to a minimum; and (b) Structural efficiency, i.e., having the minimum weight of structure to carry a given set of loads. The clear and important distinction between these two factors had not, in the lecturer's opinion, been properly realized. The first was a matter for the project office, and the second a matter for the stress office. Obviously, a weight engineer must be interested in structural efficiency but, in detail, this was the business of the stressman.

When attempting to assess structural efficiency, the weight engineer started off by plotting the weights of complete components against various parameters, usually selected with some idea of the underlying structural principles on the lines of the existing reports on wing weight. This process was normally done in stages, each successive stage being an attempt to reduce the scatter of the plots. The lecturer had been responsible for a considerable amount of work along these lines, particularly in relation to civil aircraft fuselages, a field which, strangely enough in spite of its importance, appeared to have been left almost completely unexplored.

Using the simplest possible bases, the curves shown in Fig 1 had been plotted. The weight was shown to vary with the square root of the fuselage gross surface area (i.e., a scale effect) and with length-to-depth ratio, suggesting that bending and the relationship between volume and surface area were exerting some influence. On the curves were plotted the actual points derived from weighed weights for a number of modern British and American civil fuselages, and it could be observed that the scatter was remarkably small (maximum error 5 per cent). This seemed to indicate that a good average design had been achieved, that the design conditions for different aircraft followed a similar pattern and that, because the effect of pressurizing was not noticeable its overall influence on the total fuselage weight was small.

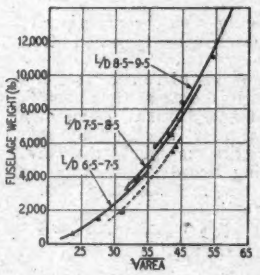


Fig. 1. Variation of fuselage weight against square root of gross area for length-to-depth ratios.

There were three aircraft whose weights all fell outside the general pattern, so far out, in fact, as to cause one to doubt the validity of the curves. These fuselages demanded a curve for themselves some 20 per cent below the general standard. This would have been noteworthy for any group of fuselages falling outside such smooth curves, but the fact that all were designed by the same company made the conclusion inescapable. A rigorous examination of the three aircraft showed them to be typical in fuselage layout, with the usual number of doors, windows, and so forth, and, in addition, two of the three were pressurized. All three were in service on scheduled air lines at the present time and it could only be presumed that their design requirements were satisfactory, since one never heard of them falling to pieces. However the fuselage weights were plotted, the same conclusion was inevitably reached: that the three aircraft in question had a structural efficiency at the very least 10 per cent better than that of all the others.

Mr. Rosenthal exemplified his interpretation of design efficiency as being that, within certain limitations, the smallest possible aircraft to carry out a given task would be the most efficient. It would weigh less, probably cost less to manufacture and would take less power and fuel to drag it along. This was entirely obvious, and yet he knew of two landplanes (able to do essentially the same job) in which the fuselage surface area of one was approximately 15 per cent greater than that of the other and, naturally, was correspondingly heavier. He also cited two military flying-boats of approximately the same gross weight, where the hull surface area of one was 30 per cent greater than that of the other. Could one reasonably conclude, when faced with these and similar factors, that every attention was *always* given to attaining the lightest possible aircraft?

With the growing use of box beam, or distributed-flange wing construction, the habit of building metal wings and then cutting holes in the main structure to accommodate tanks, bombs and undercarriages, would become a serious liability. Mr. Rosenthal had tried to assess the weight increase dependent upon the cutting of holes in wings, but his data was, he stated, somewhat scanty. On the S.R.A1 jet fighter flying boat,

WEIGHT and DESIGN . . .

where the torsion structure was cut into to allow partial burying of the float, the weight penalty was 115 lb per hole on a wing panel weight of 905 lb. On the original cut-out for the float on the Saro Princess flying boat, had the scheme been proceeded with, a penalty per hole of approximately 950 lb would have been incurred on a wing panel weight of between 23,000 and 24,000 lb.

These figures would not be of much help to other people except to indicate the magnitude of weight which was involved in such problems. However, the lecturer had gone one stage further and produced some data which he believed to be the first of their kind, relating to an actual aircraft, to have been published. In Fig. 2 was shown the weight distribution for the inner wing rear spar of the Saro Princess flying boat; this illustrated the weight penalty incurred by cutting holes in the shear webs for the jet pipes and for fuel-tank access. From this diagram, a reasonably accurate assessment had been possible as to how much the several holes had necessitated an increase in spar weight. For the double holes, it amounted to 180 to 200 lb for two holes, and for the single hole to 100 lb; the increase for each tank access hole was approximately 15 lb. The lecturer was told that the shear per inch in the area of the critical hole was 1.25 tons and, also, that the percentage of spar depth cut away by this hole was 65 per cent.

Another major point to be watched when considering the design efficiency of a civil aircraft was the problem of passenger comfort. The exact amount of volume per passenger that was necessary for reasonable comfort had not yet been established and the standards that various operators provided had long been a matter of comment. Normally, it did not come within the scope of the weight engineer to pronounce on the merits of packing passengers into large or small fuselages and, therefore, in order to discuss this aspect, the lecturer had accepted as a basis standards approximating closely to those given by Mr. Christopher Dykes, of B.O.A.C., in a paper he presented at the 1949 Anglo-American Conference.

Method of Assessment

Because of the serious influence the choice of a suitable standard could have upon the payload of an aircraft, Mr. Rosenthal said that he proposed to describe a method which he had evolved for measuring these standards in terms of weight. The method depended largely upon two main assumptions: (i) that the volume per passenger virtually established the size of the fuselage; and (ii) that the furnishings could be split logically into two groups of: (a) passenger furnishings, comprising seat, belt, water and so on, and (b) aircraft furnishings, comprising sound-proofing, partitions and so forth.

Taking the fuselage first, and referring back to Fig. 1, it could be seen that one of the major influences on fuselage weight was the surface area and, in consequence, all data concerning fuselage volume had to be related to surface area. It had been found that the surface area of a fuselage was linearly related to the two-thirds root of its volume, and it had also been established, from a number of aircraft, that the volume occupied by the passengers was approximately three-quarters of the fuselage gross volume.

The nomogram (Fig. 3) gave a convenient form of translating passenger comfort standard for any number of passengers

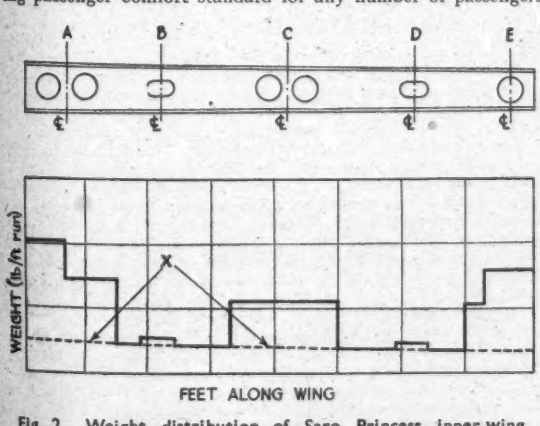


Fig. 2. Weight distribution of Saro Princess inner-wing rear-spar web. X denotes weight distribution without cut-outs; A, C, and E are engine locations; B and D are tank manholes.

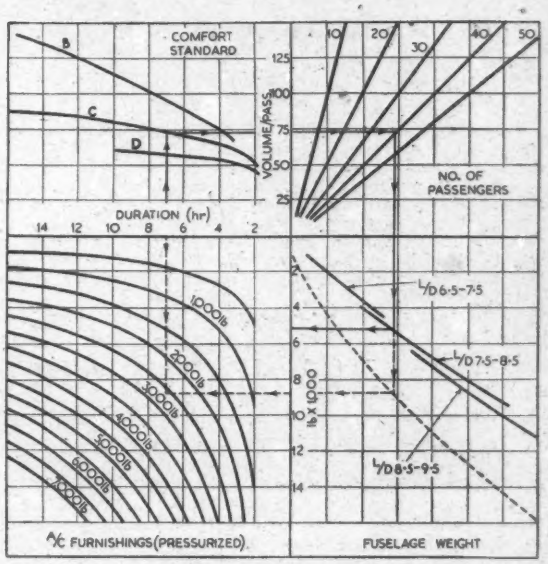


Fig. 3. Typical nomogram of fuselage and furnishing weights plotted for varying numbers of passengers in conjunction with orthodox comfort standards.

over any trip length directly into terms of fuselage weight. This could easily be followed by tracing along the thick line starting on the upper left-hand curves. Taking a typical aircraft with a seven-hour duration, "C" standard of comfort and carrying 40 passengers, the fuselage weight was seen to be approximately 5,200 lb. To find the weight for the furnishings, including pressurizing, to correspond with the fuselage weight of 5,200 lb, the dotted line should be followed to the dotted curve in the bottom right-hand corner and the furnishing weight then read off under the appropriate duration (in this case, seven hours) from the bottom left-hand graph. Although some generalizations had been made in producing this nomogram, the maximum error found when checking nine aircraft against it was 6.5 per cent.

TABLE I: WEIGHT OF PASSENGER UNIT

Item	Internal 0-4 hours (lb)	Continental 4-8 hours (lb)	Transcontinental 8 hours + (lb)
Seat	25	35	55
Belt			
Water			
Passenger service			
Passenger ...	165	165	165
Luggage ...	22 } 187	44 } 209	66 } 231
Totals	212	244	286

The figures for the group of items varying directly with the number of passengers were given in Table I. From this table and Fig. 3, the total weight of the fuselage unit comprising fuselage, aircraft furnishings, passenger furnishings and passenger could now be established. To illustrate the effects of comfort standard upon payload, two typical aircraft of 100,000 lb and 50,000 lb gross weight respectively had been chosen and a weight breakdown for these was given in Table II.

TABLE II: AIRCRAFT WEIGHT BREAKDOWN

Item	100,000 lb Aircraft (lb)	50,000 lb Aircraft (lb)
Structure less fuselage	21,000	11,200
Power tanks and system	22,000	11,000
Airframe equipment	4,000	3,000
Crew	1,000	900
Fuel	27,000	7,400
Item totals	75,000	33,500
Fuselage furnishings and passengers...	25,000	16,500
Gross weight	100,000	50,000

For the 100,000 lb aircraft with a duration of twelve hours, changing from "B" to "C" comfort standard had the effect of increasing the number of passengers that could be carried from 39 to 47, an increase in payload of over 20 per cent.

WEIGHT and DESIGN . . .

Similarly, on the 50,000 lb aircraft, flying for six hours, changing from "C" to "D" standard would improve the payload by nearly 8 per cent.

It would be seen from these figures how important was this study and how irrational it might be to compare the weights and economics of civil aircraft without due regard to the standard of comfort provided. This completed the lecturer's illustrations of what he meant by design efficiency and which, he emphasized, was primarily the responsibility of the project department. It was the project stage that decided whether a design should be light or heavy and it was at this stage that the most weight could be saved at the least cost in design time and money.

The intense amount of work being put into the study of the aerodynamic and structural problems on modern aircraft was not being followed with a similar programme relating to weight prediction methods. This was rather surprising when one considered that, for a particular aircraft, the aerodynamic and structure calculations were based upon the weight estimate, and at the moment this depended as much upon the intuition of the man making it as it did upon the useful data at his disposal.

Because of the unsatisfactory state of affairs which prevailed in the past, a new pattern for the collection of weight data was being evolved. The industry, through the S.B.A.C., was giving active support and considerable encouragement to the work, but the lecturer wondered whether responsible people, both in the government establishments and in the industry, really knew how little labour was available for the job and how much its success depended upon the energies of a small group of men.

LONDON AIRPORT PROGRESS

(*Continued from page 795*)

ments. The chief maintenance area (No. 1 site) is situated to the east of the runways and is over 240 acres in extent. It will be used by B.O.A.C. and B.E.A.C. No. 2 maintenance area is situated to the south-east of the runways, occupies over 70 acres, and will be used by the Commonwealth and foreign airline companies. A further 90-acre maintenance site (No. 3) is being reserved for future commitments. Development of a separate permanent freight area is planned north of the western end of No. 1 runway.

Part of the present programme calls for the construction of a "fuel farm" (to be located on No. 3 maintenance site), which will enable suppliers to store up to 2,000 tons of fuel, thereby replacing the present temporary storage tanks. It is understood that the question of pipeline delivery to the central terminal area is under consideration and it is expected that the pipeline system may later be extended to permit the pumping of fuel direct to the aircraft at a speed of 300 to 400 gallons per minute per aircraft.

Some idea of the extent of the civil-engineering achievement which the construction of London Airport represents may be obtained from the following statistics. A total of 120 acres of ponds and gravel-pits was filled in, and, before this work could be done some 100,000,000 gallons of water and 860,000 cu yd of silt had to be removed. During the construction of the first three runways and the perimeter tracks the average daily output of high-grade concrete was 1,500 cu yd. The total volume of concrete laid to date is 680,000 cu yd. On all runways, taxi-ways and aprons which were completed under the first contract, the high-grade concrete was laid to a depth of 12in, directly on gravel. Up to August 31st, 1949, 70 per cent of contract No. 2, which entailed the construction of three more runways and the central aprons, had been completed. For the second contract it was decided that a base layer of 8in of concrete should also be laid.

A large amount of drainage was needed to provide for the disposal of rain-water falling on the concrete areas, and the total length of storm-water drains laid up to last October was 75 miles. The volume of excavation to date is in the region of 9,100,000 cu yd, and airfield lighting ducts 98 miles in length have been laid.

The area of the original site (the three-runway scheme) was 1,500 acres and the future area for the final civil aviation scheme entails construction on some 4,600 acres. The surface of the aerodrome is almost entirely flat, the fall across the site from N.W. to S.E. being 6ft, and from N.E. to S.W. being only 2ft.

Between the runways nearly 700 acres of grass are being cultivated, all levelled to a 2in tolerance and surfaced to a maximum gradient of 1 in 80, as the slightest deviation would result in puddles, with, near the runway edges, a possible danger to aircraft.

Radio and telecommunication arrangements can be broadly placed under three headings: point-to-point, mobile aeronautical communications, and radio aids. The airport is the signals centre for South-Eastern England, and teletype lines are provided to adjacent European countries, with W/T. links to more distant European destinations. Under the mobile heading, H.F. and V.H.F. R/T. are used for approach and airport control, H.F. W/T. being reserved for North-Atlantic-route aircraft communications. Radio aids available include G.C.A. (either used as a primary aid or as a monitor for I.L.S. approaches), I.L.S. equipment, S.B.A., Eureka, V.H.F. D/F. (manual), V.H.F. cathode-ray D/F. and M/F. Radio Range. During the month of October—the latest for which a report is available—309 G.C.A. approaches were carried out, making a total of 6,181 G.C.A. approaches to date.

The runway and approach lighting systems were in themselves a major constructional enterprise. High-intensity contact lights are installed along the length of No. 1 runway and on the eastern approach two distinct installations, the "line and bar" and the "red vee" systems, are used. The vee is a low-intensity system for use under normal night conditions; the line and bar has a high-intensity centre-line with seven cross-bars of sodium lights. There is also a low-intensity line and bar installation at the eastern end of runway No. 1 which is carried on the existing line and bar structure. On all other runways, omni-directional lights (one row on each inset, 75ft from the edges) are used on all approaches apart from No. 1 runway, sodium funnels are installed. For airport identification two aerial beacons are utilized, one a green identification beacon flashing "VA," and the other an alternating white-green airport location beacon, situated at Heston, about one and a half miles distant.

A unique electronically operated remote-control system for the entire airport lighting system is installed in the control tower and obviates the necessity for the hundreds of cables which would be required for a direct-wire system.

Traffic at London Airport is constantly increasing, and a total of 17 companies now use it on regular services. During 1948, totals of 16,764 landings and 16,791 take-offs were recorded. For the month of August, 1949, aircraft movements amounted to 4,129, representing some 47,000 passengers handled, and showing a considerable increase over the figure for August, 1948, when figures of 3,699 aircraft movements and 42,000 passengers handled were achieved.

The ultimate cost of this vast enterprise has been recently estimated at £26,000,000 and, while no foreseeable date is yet envisaged for the completion of the project, it is thought that London Airport will eventually be the world's most well-equipped and up-to-date, if not the largest, international air terminal.

TOLERANCING STANDARDS

WHEN the current edition of B.S. 308 (*Engineering Drawing Office Practice*) was published, it was announced that the subject of tolerancing would be dealt with in a separate publication. A draft B.S. 308: Part II (*Dimensioning and Tolerancing*) is now in circulation for comment.

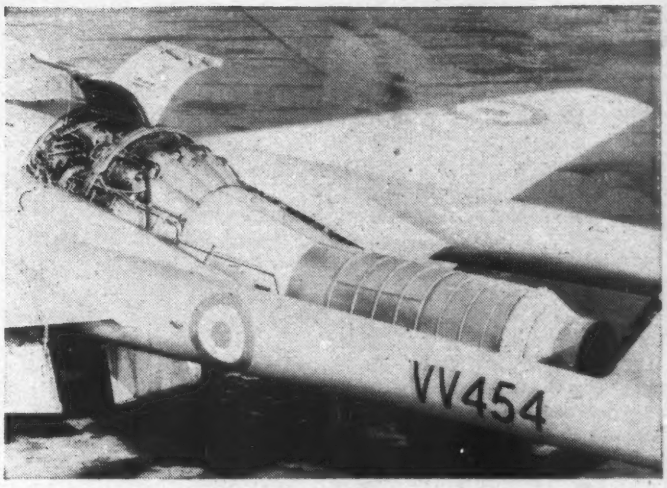
The subject is a difficult one, and a period of five months—until March 31st, 1950—has been allowed for comment in order to give manufacturers an opportunity to appreciate fully the implications of the system as applied to industrial practice. It is desirable that a common system, equally acceptable to the needs of industry and the Services, should be evolved, and that the present opportunity for commenting on the draft before it is approved as a British Standard should be widely known and used.

In connection with the British Standard for conversion factors and tables (B.S. 350:1944), Addendum No. 1 has recently been published. It contains additional definitions, conversion factors, multiples and tables relating to cubic measures, weights, pressures, force, concentration and traffic units, and a set of factors and multiples and a few extended tables for the conversion of units of thermal conductivity and conductance, heat flow and viscosity.

Copies of B.S.I. publications may be obtained from the British Standards Institution, 24, Victoria Street, London, S.W.1.

TAILPIPE REHEAT

A Specialized Research Programme Reviewed: Potentialities Assessed



Goblin with reheat tailpipe installed in Vampire fighter. Cowlings are removed for inspection.

By JOHN L. EDWARDS, B.Sc., A.M.I.Mech.E.*

THE principle of the ramjet is to convert the velocity energy of a high-speed air stream to pressure energy by means of a suitable duct, to apply heat energy to the compressed air and then to expand this heated air in the form of a high-velocity jet. The advantage of such a mechanism is an increase in thrust given by the product of the mass flow of air and the difference in velocities between entry and exit, while the disadvantages are (i) the necessity to project the duct at high forward speed before any thrust is obtained and (ii), except at very high speeds, a low thermal efficiency.

One application of the propulsive duct, however, is to append it to the exhaust of a turbojet unit. By adding more heat to the gas stream it is finally ejected to atmosphere at enhanced velocity, thus increasing the change of momentum and hence the total thrust. This is the system of "exhaust reheat" or "afterburning" illustrated diagrammatically in Fig. 1.

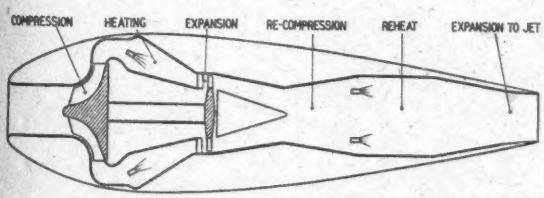


Fig. 1. Diagrammatic arrangement of turbojet with reheat.

If an alteration to the exhaust system of a turbojet unit has the effect of increasing the temperature of the gases passing through the propulsion nozzle then, for a given size nozzle, the mass flow will fall and the pressure in the exhaust cone will rise. These changes will be transmitted through the entire unit and will result in the compressor moving near the surge point and the pressure drop across the turbine decreasing.

If an increase in the area of the propulsion nozzle is effected concurrently with the increase of gas temperature at the final jet, the rate of mass flow and the turbine pressure drop may be unchanged. The compressor-turbine combination is then unaffected by the reheat, but unless a means of reducing the nozzle area for normal running is incorporated, a severe loss in thrust can be anticipated when the unit is operated without reheat. The obvious, but far from simple, answer to this problem is a variable-area nozzle.

Economical operation will be obtained only if velocity at entry to the reheat section is reduced to a minimum. The thermodynamic efficiency of any cycle depends on the temperature ratio or, alternatively, the pressure ratio, of the operating points. In the case of a fixed heat supply and a fixed exhaust pressure, then the higher the pressure before heat is supplied the greater will be the pressure ratio of the subsequent expansion and the higher the thermal efficiency. This optimum pressure, in the case of subsonic flow, is limited to that given by the critical pressure ratio and can be obtained only by diffusing the gases entering the reheat zone to the lowest possible Mach number, and highest possible pressure, before adding heat. In this manner the thermal efficiency of the reheat process will be a maximum and the added fuel consumption a minimum. Thermal and combustion efficiencies must not be confused. A high value of thermal efficiency means an efficient cycle and a high thrust for a given consumption of available oxygen. A high value of combustion efficiency means an economical fuel-consumption which, in this application, is of secondary importance when compared with the effect produced.

From the temperature/entropy diagram (Fig. 2) it will be seen the air enters at atmospheric pressure —possibly with precompression due to ram — and is compressed with some increase of entropy. Heat is applied at nominally constant pressure and the gases are expanded through the turbine. On a normal turbojet unit the gases would then be expanded through the nozzle to form the propulsive jet. With reheat, however, the gases undergo diffusion, are then further heated at the expense of some loss in total pressure, and finally expanded through the propulsion nozzle. The increase in temperature makes more energy available for conversion to kinetic energy, but also increases the amount of heat rejected in the wake, thus giving an increase in thrust at the expense of a decrease in thermal efficiency.

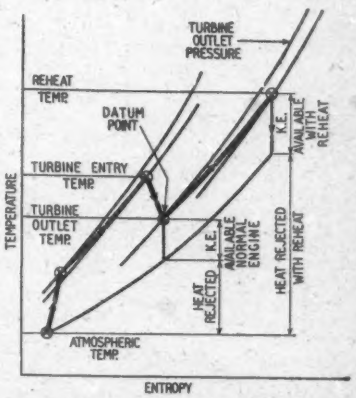


Fig. 2. Temperature/entropy diagram of reheat cycle.

A simple relationship between proportionate thrust increase and nozzle size is obtainable if it be stipulated that all losses are neglected, the Mach number in the propulsion nozzle is less than unity, and the turbine conditions maintained steady by means of a variable nozzle.

For a given Mach number the non-dimensional mass flow remains constant, and we can therefore write:

$$\frac{W_a\sqrt{T_5}}{A_5 \quad P_5} = \frac{W'_a + W'_f\sqrt{T'_5}}{A'_5 \quad P'_5}$$

From the assumptions made, and neglecting the fuel flow into the tail pipe, we obtain:

$$\frac{A'_5}{A_5} = \sqrt{\frac{T'_5}{T_5}}$$

In the same way, the non-dimensional velocities with and

*Combustion research engineer, de Havilland Engine Co., Ltd.; in a paper (of which this is a digest) "Design of Tail Pipes for Jet Engines including Reheat" presented at the R.Ae.S., December 6th, 1949.

TAILPIPE REHEAT : : :

without reheat are equal, whence we may write:

$$\frac{V_5}{\sqrt{T_5}} = \frac{V'_5}{\sqrt{T'_5}}$$

$$\frac{V'_5}{V_5} = \sqrt{\frac{T'_5}{T_5}}$$

The thrust for a given mass flow under static conditions is directly proportional to the jet velocity, and therefore:

$$\frac{F'}{F} = \frac{V'_5}{V_5} = \sqrt{\frac{T'_5}{T_5}}$$

or the thrust and nozzle size increase directly as the square root of the absolute gas temperature. The fuel consumption is given by the expression:

$$W_f \times \text{Calorific Value} = (W_a + W'_f) \times C_p \times (T'_5 - T_5)$$

SYMBOLS USED

( ) indicates reheat conditions. A_5 area, propulsion nozzle. C.H.U. Centigrade heat unit. C_p specific heat at constant pressure. CV calorific value. F thrust. I combustion intensity. P_5 total pressure, propulsion nozzle. T_5 total temperature, propulsion nozzle. V_5 velocity, propulsion nozzle. W_a air mass flow. W_f fuel mass flow.

Naturally, these figures will differ somewhat from those obtained in practice, but for the sake of comparison values are shown on Fig. 3 as they would apply to a Goblin unit. It will be seen that for an increase of 30 per cent in s.l.s. thrust a reheat specific consumption of 4.2 lb/hr/lb would be required. Fig. 3 shows that for this case an ideal temperature ratio of 1.68 is required, although the actual temperature will be higher when all necessary adjustments for losses are made.

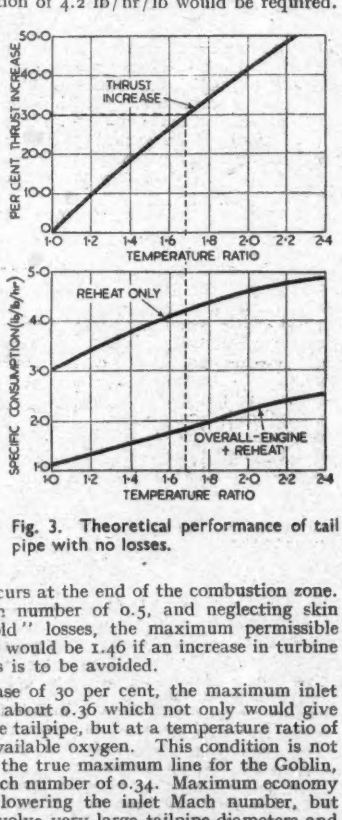


Fig. 3. Theoretical performance of tail pipe with no losses.

The various values of the inlet Mach number and temperature ratio are given in Fig. 4 and the conclusion to be drawn may be summarized as follows:

(a) The lower the inlet Mach number the smaller is the loss in total pressure due to combustion.

(b) If the inlet Mach number is in excess of 0.35 it will not be possible to exceed a temperature ratio of 2.3 before choking occurs at the end of the combustion zone.

(c) At an inlet Mach number of 0.5, and neglecting skin friction and "cold" losses, the maximum permissible temperature ratio would be 1.46 if an increase in turbine unit temperatures is to be avoided.

For the desired increase of 30 per cent, the maximum inlet Mach number would be about 0.36 which not only would give choking at the end of the tailpipe, but at a temperature ratio of 2.2 would use all the available oxygen. This condition is not wholly satisfactory and the true maximum line for the Goblin, see Fig. 5, is an inlet Mach number of 0.34. Maximum economy would be obtained by lowering the inlet Mach number, but below 0.2 this would involve very large tailpipe-diameters and the penalties of increased weight and cowlings. Further, the rate of proportionate increase between M=0.3 and M=0.2 for a 30 per cent increase in thrust is small.

Small losses are inevitable in any form of air flow ducting, due to friction and eddy formation. A stable flame cannot be formed in a moving gas stream unless the flame velocity exceeds the gas velocity. Flame velocities of 25-30 ft/sec can be expected, a figure well below that of the gases in a tailpipe even after diffusion. Accordingly, some form of stabilizer must be used to form eddies, thus reducing the local velocity to a figure at which continuous burning can proceed. Inevitably such a stabilizer will introduce losses.

The introduction of an obstruction in the tailpipe tends to increase the pressure drop from the turbine to the nozzle for a given gas flow and, if no change is made in the nozzle size, will lead to a decrease in pressure ratio across the turbine and a drop in turbine speed. If the speed is to be restored the turbine entry temperature must be raised by increasing the amount of fuel, which will not only increase the total temperature of the gases at the nozzle but may give a greater thrust.

To obtain a true conception of "cold" losses a common datum was necessary and turbine outlet conditions were selected. The correction to be applied to the observed thrusts to reduce them to this common level can be obtained from comparative test bed figures with different nozzles, or it can be calculated. A conservative value of 1.5 per cent is taken as the basis on an analysis of test results, but the fitting of a variable nozzle may increase this value.

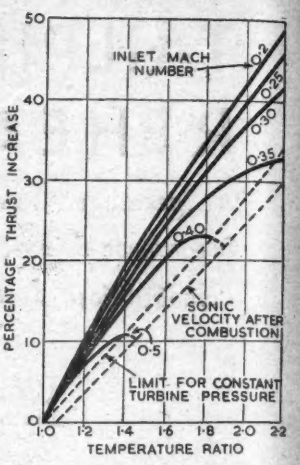


Fig. 5. Theoretical increase in thrust of Goblin unit under s.l.s. conditions.

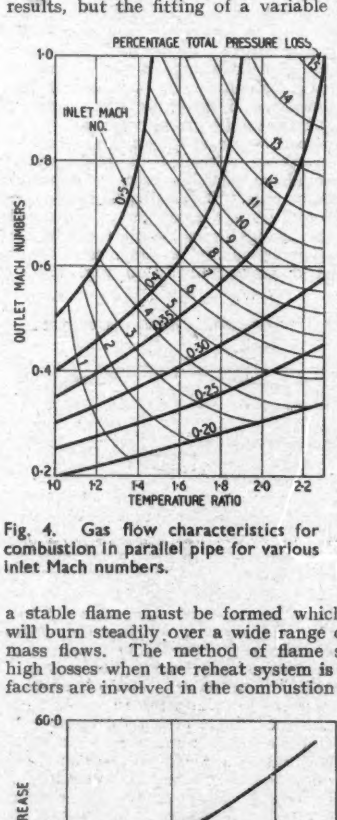


Fig. 4. Gas flow characteristics for combustion in parallel pipe for various inlet Mach numbers.

The effect of reheat at varying forward speeds is best illustrated from the application quoted, namely, 30 per cent reheat on the Goblin. Changes in altitude affect the proportion figure slightly, but in general it is less than 2 per cent and its effects have been averaged out. Fig. 6 shows the variation in proportionate thrust increase for a given temperature ratio with forward speed, at all altitudes up to 50,000ft.

Some idea of the general trend of fuel consumption may be obtained from the curves in Fig. 7 showing variation in specific consumption at various speeds and altitudes and changes in the amount of reheat. For the combustion system to function smoothly a stable flame must be formed which is easily ignitable and will burn steadily over a wide range of mixture strengths and mass flows. The method of flame stabilization must avoid high losses when the reheat system is not in operation. Many factors are involved in the combustion process and information, gathered from many reports, indicates conflicting conditions.

(a) The high temperatures at which combustion is initiated aids vaporization, widens the stability limits and tends to produce a short flame.

(b) The high pro-

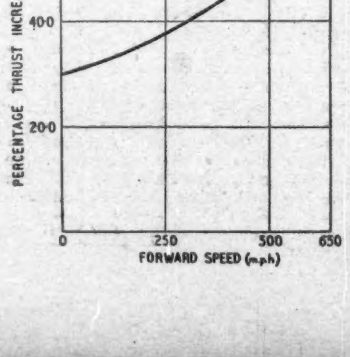


Fig. 6. Effect of forward speed on proportionate thrust at all altitudes from sea level to 50,000ft.

TAILPIPE REHEAT . . .

portion of nitrogen in the gases, together with the presence of CO_2 and H_2O, tends to slow reaction, increase the flame length and narrow the stability band.

(c) The effect of velocity tends to concentrate the fuel around the stabilizer. Consequently the rich-extinction point will occur earlier at high velocities than low

It is impossible to lay down precise rules regarding stabilizer design and methods of fuel injection. The practical approach is that of trial and error. The temptation is to effect ignition of the mixture spontaneously. Air and fuel are well mixed, the fuel will be vaporized when it reaches the stabilizer, and under sea level conditions a pressure of 26-30 lb/sq in will exist in the tailpipe. Cool flames form at temperatures up to 700 deg C, but no true combustion will take place until about 800 deg C is reached. However, despite the possibility of spontaneous ignition at take-off, it is very unlikely that it would occur at altitudes where the maximum absolute tailpipe pressure may not exceed 6 lb/sq in.

It is fairly well established that fuel injection can be effected satisfactorily by the use of plain jets. The major difficulty appears to be localization of the fuel in the body of the air, giving rise to uneven distribution in the jet pipe. This can be mitigated by positioning the jets well upstream of the stabilizer, but radial localization of the mixture is then more difficult and ignition may occur only when quite a large proportion of the gas is above the weak limit. This implies a sudden, uncontrolled rise in thrust at low boosts and is better avoided.

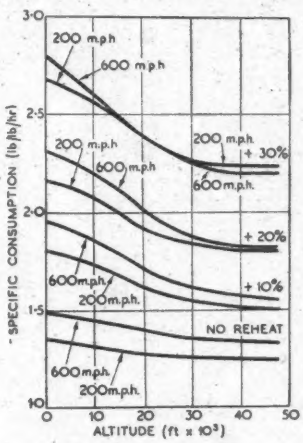


Fig. 7. Effect of reheat on specific fuel consumption.

Combustion - chamber volume may be determined from a consideration of combustion intensity, the criterion for this being the heat input per atmosphere per hour per cubic foot as given by:—

$$I = \frac{W_f \text{ (lb/hr)} \times CV \text{ (C.H. U/lb)}}{P(\text{atn}) \times \text{Volume (cu ft)}}$$

An approximate method of determining minimum combustion zone diameter involves an assumption of effective flame velocity. This is difficult to assess, but a figure of 30 ft/sec is reasonable. In a high-speed gas stream an explosion flame front would move radially at the relatively slow flame speed and downstream at the gas speed plus the flame speed. In a reheat chamber this would be influenced by the measure of recirculation essential for a self-supporting flame. Accordingly, the flame is envisaged as a hot central core surrounded by a conical envelope, the solid angle of which will be determined by the resultant of the gas velocity and the flame velocity.

The design aims in the Goblin reheat system were:

(a) Good ignitability under all flight conditions, the reheat lighting up without shock and subsequently being opened smoothly to full thrust.

(b) Wide stability limits with special emphasis on the weak end to ensure smoothness and pilot's control.

(c) Low "cold" loss due to stabilizers, in order to give approximately normal operation without reheat.

(d) Reasonable combustion pressure-loss and efficiency, consistent with a realistic tailpipe for installation in single-engined fighters.

(e) Good mechanical reliability and cool operation of pipe and nozzle.

(f) Variable degree of reheat under pilot's control to be interconnected with a variable nozzle to ensure optimum operating conditions.

Not all these aims have yet been achieved. In the early work, efforts were concentrated on obtaining good stabilization and light-up. The system of individual stabilizers was soon dropped and a vee-section ring was selected for reasons of stability, good light-up and reliability. Two ignition plugs were fitted, although one proved sufficient to give smooth ignition with a thrust increase of only 100-150 lb. A variable nozzle was not fitted since the design presented many difficulties not yet overcome. The amount of thrust increase was therefore dictated by the thrust available without reheat which had to be sufficient for take-off. A series of bench tests was conducted using nozzles of three different diameters to obtain a range of operation up to 20 per cent thrust increase.

Investigation into the general behaviour of reheat at altitudes can only be carried out in this country by installation in an aircraft, and accordingly a Goblin-engined Vampire was adapted as shown in the heading illustration. The fuel system comprised two Lucas pumps supplying fuel through two branches: one to the normal control box and the other to a special reheat shut-off cock and control box operated by a single lever in the cockpit. Flight clearance was obtained on completion of a 25-hr special-category test, and installation and preliminary clearance flights were completed without incident.

General performance proved to be good. A thrust increase of 13 per cent at sea level was obtained, which would increase to nearly 20 per cent at 400 m.p.h. and 25 per cent at 600 m.p.h. These thrust gains resulted in an increase of over 40 m.p.h. in maximum forward speed and a 30 per cent reduction in the time required to climb to operational height. There was no sign of rich extinction when the air flow was cut down by reducing the engine speed, and weak extinction occurred only when the fuel was shut off completely. Aircraft handleability was slightly affected as in order to accommodate the extended tailpipe it was necessary to tilt it upwards at 6 deg from the longitudinal axis of the Goblin unit. This gave a nose-up effect which altered the trim. Apart from a slight vibration when reheat was in operation the aircraft was otherwise normal and there were no signs of overheating of the tailpipe.

This research programme has made clear the inherent possibilities of the reheat system. It provides proportional increases of thrust up to 45 per cent for take-off and up to 85 per cent for combat at 600 m.p.h. Specific fuel consumption will rise to a value of some 3 lb/hr/lb for the above conditions, but when considered in relation to the improved rate of climb, the amount of fuel required to reach operational altitudes is not excessive. The installation of stabilizers and the variable nozzle will decrease the tailpipe efficiency under normal conditions. The use of very high temperatures—some 2,200 deg K—renders difficult the mechanical construction of a variable nozzle. There appears no reason why a reheat system should increase installation weight by more than 30 per cent of the normal engine weight. Since in this manner a small engine is given a maximum power which could only be equalled by a much larger power unit, this does not seem a high price to pay.

NAVAIDS

ENTITLED *Navigational Systems and Instrument Aids*, a paper of considerable merit was presented by Doctors D. E. Adams and A. M. Uttley before the R.Ae.S. on December 15th.

After dealing with the general requirements and dilating upon the essential differences between civil and military navigational problems, the paper went on to include a comprehensive survey of the current navigational systems.

Some useful information was given on the influence of navigational equipment on aircraft design, particularly in relation to weight-saving and the reduction of drag. In the latter connection, the employment of dielectrically isolated sections of the aircraft itself as an aerial (for dekametre wavelengths) and the use of slot aerials for metre wavelengths was particularly noteworthy.

In relation to the future, it was suggested in the paper that, as equipment becomes more reliable, it would seem likely that the number of crew members would be reduced; we already had the automatic pilot and this would be followed by the automatic navigator and the automatic engineer; but judgment and decision would always remain.

For passenger travel, aircrews would be essential for an indefinite period, but it was possible to foresee the automatic delivery of mail and freight with take-off and landing conditions outside those which could be tolerated by human beings, so easing the serious problems of airfield space and the utilization of existing airfields. The military counterpart would be the expendable pilotless bomber, which would present a much more difficult problem, for the very reverse of co-operation could be expected at the receiving end.

With ground assistance, there was no fundamental problem; the civil problem was more one of organization. When active opposition had to be encountered, the case was quite different; here, navigational effectiveness, taking into consideration other aspects of the operational rôle—reconnaissance, interception or bombing—must inevitably take precedence over simplicity or cheapness.

SERVICE AVIATION

Royal Air Force and Naval Aviation News and Announcements

R.A.F. Station Honoured

BRIDGNORTH, Salop, is to confer the freedom of the borough on the nearby R.A.F. station, which is at present a recruit centre attached to Transport Command. The provisional date for the ceremony of "right of entry," an honour unique in R.A.F. history, is April 12th, 1950.

Honorary Appointment

THE King has approved the appointment of Air Chief Marshal Sir Douglas Evill, G.B.E., K.C.B., D.S.C., A.F.C., as Honorary Air Commodore to No. 3617 (County of Hampshire) Fighter Control Unit, R.Aux.A.F. Sir Douglas Evill, who retired from the Service in January, 1947, was Senior Air Staff Officer of Fighter Command throughout the Battle of Britain. After a period in Washington as Head of the R.A.F. Delegation he later became Vice-Chief of the Air Staff.

Boy Entrants Graduate

AIR MARSHAL SIR JOHN WHITWORTH JONES, K.C.B., C.B.E., inspected 129 boy entrants on the occasion of their passing-out parade held at Locking on December 8th. The reviewing officer, who was accompanied by A.V-M. L. G. Harvey, C.B. (A.O.C., No. 24 Group), congratulated the boys on their smart turn-out and said that there were still very real and growing opportunities in the Service. Boy entrants were provided with eighteen months of first-class education in a decent and agreeable community with lots of spirit and entertainment.

The review, which was marred by inclement weather, was attended by parents and friends of the passing-out entry. About 600 boy entrants were on parade and, with the exception of No. 5 Regional Band, no officer, N.C.O. or airman took part in the parade. It was controlled entirely by Sgt. Boy Entrant Wick, with other N.C.O. boy entrants as subordinate commanders.

Nine of the boys on parade succeeded in passing out at L.A.C. standard. The prizewinners were:—

Best Tradesmen: Airframe mechanic—B.E. G. F. Fabb; armament mechanic (Kirkham)—B.E. E. G. Maskell; electrical mechanic—1st, L.B.E. R. S. Erskine, 2nd, L.B.E. K. A. Fuller; engine mechanic—1st, L.B.E. M. W. Ewbank, 2nd, B.E. M. J. Carlile; instrument mechanic—B.E. D. Firmager.

General Service Efficiency: Locking—Sgt. B.E. D. G. Judge; Kirkham—Sgt. B.E. N. E. Cunliffe.

Highest Education Marks: Locking—L.B.E. K. A. Fuller; Kirkham—B.E. E. G. Maskell.

Highest Aggregate—Order of Merit: Locking—L.B.E. R. S. Erskine; Kirkham—B.E. E. G. Maskell.

NAUTICAL SHOT: A typical scene from the Marine Craft Training School at Calshot, where airmen are taught seamanship. The R.A.F. Marine Branch, formed some twelve months ago, operates 500 vessels on flying-boat servicing, target-towing, rescue and other air-sea duties.

New Air-sea Link

SPEAKING at a R.A.F.V.R. dinner in Nottingham recently, Mr. Geoffrey de Freitas, Under-Secretary of State for Air, made the first announcement of a new plan for exchanging officers between the R.A.F. and Navy. "R.A.F. officers," he said, "will be sent to fill established posts in the Navy, and they will carry out the full duties as if they were Naval officers. It will be the same with the Naval officers posted to the R.A.F."

In this way, over the years, a body of officers in each service would grow up knowing the other service. Mr. de Freitas said that the difference between the two services was perhaps over-emphasized—"The R.N. and the R.A.F. are each justly proud of their distinctive features, but we must not forget that the qualities essential to great fighting services are common to both."

607 Squadron's Memorial

A MEMORIAL tablet to those members of No. 607 (County of Durham) Squadron who gave their lives in the last war was unveiled in Durham Cathedral on December 4th by Air Marshal N. M. Foster, C.B., C.B.E., D.F.C., the Air Officer Commanding-in-Chief, Reserve Command. The ceremony, which began at 3.30 p.m., was preceded by an inspection of a Squadron guard of honour by Air Marshal Foster. Many past and present members of the Squadron, including several Battle of Britain pilots and comrades of those who fell, were present, and the cathedral was filled almost to capacity. The ceremony, which was incorporated in the Service of Evensong, was conducted by the Dean, The Very Reverend Cyril Alington, D.D., and attended by the Bishop of Durham. The first lesson was read by the Right Honourable Viscount Runciman, O.B.E., A.F.C., the Honorary Air Commodore of No. 607 Squadron.

During the morning of the same day a present pilot of the Squadron, Pilot Officer Leslie Oates, of Penteland, Newcastle, lost his life when the Spitfire he was flying crashed into the sea off the coast of Northumberland.

FUEL PROOF: Last week reference was made to the green, rubberized working uniform worn by servicing personnel at Odiham. The photograph shows that the new clothing not only gives full protection against the penetrating, odorous effects of aviation kerosene, but is also a considerably neater dress than the usual overalls. Rubber boots are worn to prevent damage to aircrafts' high-speed finish.
"Flight" photograph.